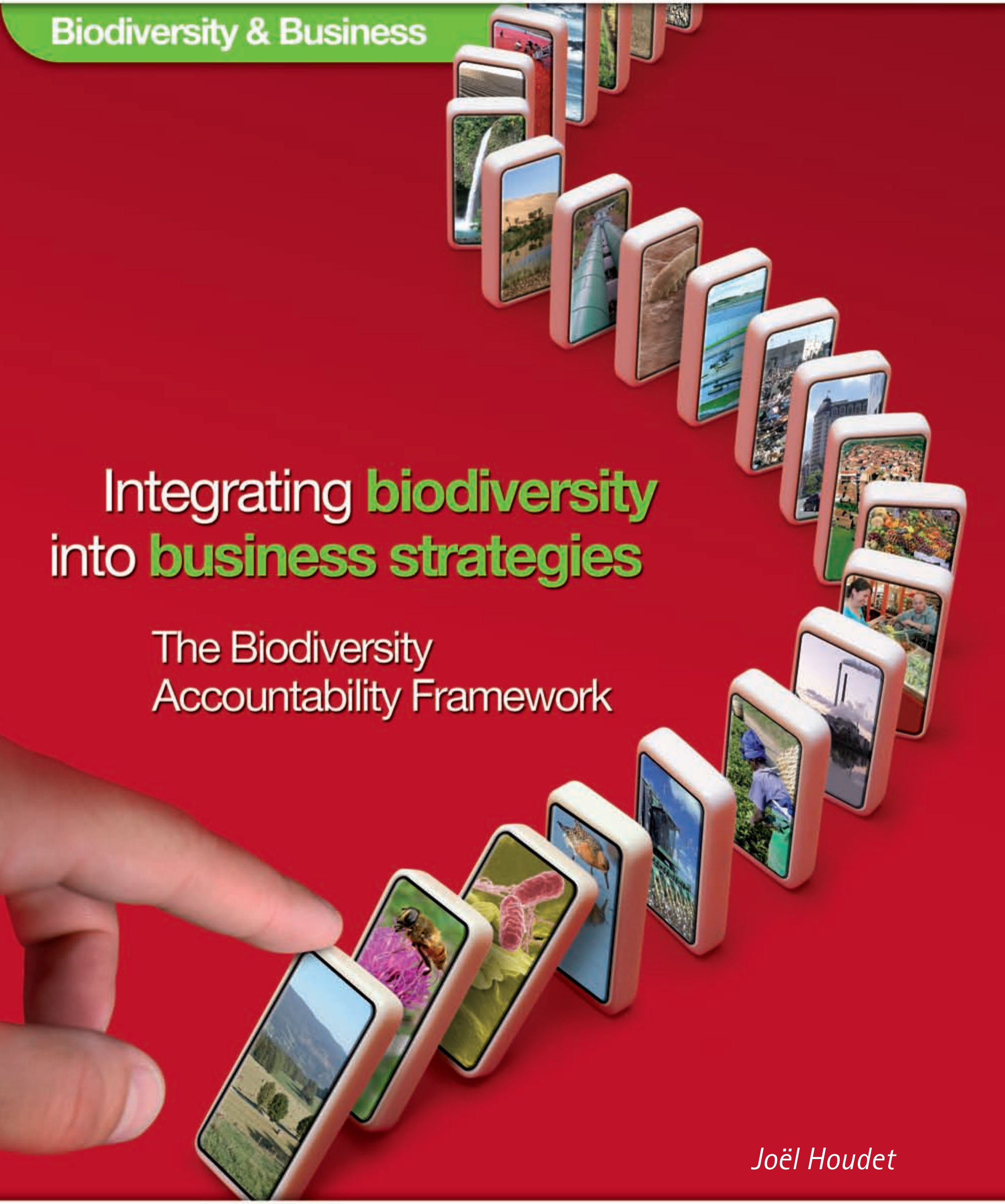
Biodiversity & Business



Integrating biodiversity into business strategies

The Biodiversity Accountability Framework

Joël Houdet

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FONDATION POUR LA RECHERCHE SUR LA BIODIVERSITÉ

orée
Entreprises, territoires et environnement

INTEGRATING BIODIVERSITY INTO BUSINESS STRATEGIES
The Biodiversity Accountability Framework

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Thanks go also to the whole team at *Orée*,
and in particular to Marc BARRA for his help on the companies' self-assessments with respect to the *Business and Biodiversity Interdependence Indicator* (BBII).

Lastly, I would like to thank all the people and organisations who have contributed articles and self-assessments, and CREED-Veolia Environnement for funding the research project (CIFRE fellowship – PhD thesis).

The concept of biological diversity, or biodiversity, presents a real challenge to businesses.

In response to this challenge, in February 2006 the Institut français de la biodiversité (IFB, one of the two organisations that merged to give rise to the Fondation pour la recherche sur la biodiversité, FRB) and Orée initiated a Working Group "how can we integrate biodiversity into business strategies".

Some thirty businesses, including both multinationals and small and medium enterprises, as well as local governments and representatives of non-profit organisations and government ministries, participated in the study group. It was co-chaired by Jacques Weber, director of the IFB, and François Laurans, then deputy director for research of Veolia Environnement, who was succeeded in 2007 by Mathieu Tolian from Veolia's Department of environmental performance. Bruno David, chair of IFB's scientific committee, and Michel Trommetter, a member of the same committee, have actively participated in the Working Group.

A CIFRE fellowship (PhD thesis) on the topic, funded in part by Veolia Environnement, has been carried out concomitantly to the Working Group's work.

Three years after the Paris Conference on "Biodiversity: Science and Governance", the IFB-Orée Working Group has succeeded in demystifying the concept of biodiversity for businesses and has shown them that their dependence on biodiversity is even greater than their effect on it.

"Integrating biodiversity into business strategies: the Biodiversity Accountability Framework" is thus an eagerly awaited book and a remarkable demonstration of the IFB's ongoing commitment to its mission of knowledge transfer and communication of expertise.

The FRB is pleased and proud to co-publish this work and looks forward to pursuing the cordial and solid relations already established, within the context of this Working Group, with a substantial number of businesses who are now its partners.

Xavier LE ROUX, Director, FRB

Businesses and biodiversity: economics and life

In 1979, René Passet published a groundbreaking work on environmental economics, *"L'Economique et le vivant"*, in which he represented the world as composed of three concentric spheres: the *ecosphere* or economic sphere, the *sociosphere* or social sphere and the *biosphere* or living world, which encompasses the other two. These spheres, says Passet, are not autonomous: matter, energy and information are exchanged between them. This representation of the world, though schematic, is extremely interesting as an illustration of the interdependence of the economy and society with the biosphere.

Passet's conception has the additional merit of presenting the biosphere as a whole, which fits with the current scientific understanding of biodiversity. The term itself was coined by E. O. Wilson in 1988, four years before the 1992 Rio Conference, and has been defined in many ways since then. The French National Biodiversity Strategy (MEDD, 2004), has adopted this one:

"Biodiversity is an essential dimension of life. It takes the form of genetic diversity, diversity of species and diversity of ecosystems. It carries the evolutionary potential which guarantees the adaptability of species and ecosystems in the face of global change. Biodiversity is a vital issue for human societies because of the goods and services it provides. The uses which have been made of it have marked the landscapes and have shaped it in return. It is permeated with symbolic, cultural and community values. We humans must preserve the diversity of the living world on ethical, cultural, biological, ecological and economic grounds".

Some people argue that technology can overcome the consequences of species loss and, to paraphrase the public query of a prominent member of the French Academy of Medicine *"after all, what does the extinction of whales or giraffes have to do with us?"* This question presupposes a view of the living world as merely the sum of its parts, but scientists are now in agreement that biodiversity is the outcome of the interactions among organisms in changing environments. Medicine can tell us about the muscles, bones, nerves, genes and proteins of an organism, but can it tell us how a collection of organs becomes alive?

Viewing the world as composed of a collection of juxtaposed species is consistent with the type of thinking about nature from which the naming and classification of species developed. When all the species of the world had been identified and samples of every species had been collected, we would have lost biodiversity, which resides in the interactions between these species.

Suppose there was only one planetary living system, with the capacity to adapt to local conditions (temperature, pressure) in all types of environment, from mountain peaks to ocean depths, under every sort of extreme conditions. One way for this living system to adapt would be to produce *adaptive emergences*, which we call species. Humans themselves would be simply the result of one adaptive emergence within this living system, occurring in the Rift Valley in East Africa a few million years ago.

This definition is one of the most comprehensive available and the most relevant to the subject of this work, in that it accentuates the importance of diversity and adaptability in the dynamics of living systems. It also highlights the dependence of the economy on the living world. Accordingly, the erosion of biodiversity can have nothing but negative effects on business.

Interaction is the keyword of life. We must interact to co-operate, to procreate, to change the environment in which we evolve and to adapt to the natural evolution of that environment. In the same way, interaction with the entire living world is vital for us: we eat nothing but living organisms - vegetables, fruit, meat - and we co-operate with living organisms to obtain other products, such as those which require fermentation - beer, wine, cheese and bread, among others. Our buildings are largely composed of material derived from living systems. Fossil fuels and limestone are also inherited from the biodiversity of past eras, as is the very air we breathe.

Businesses too are involved in those interactions with the living world:

- From it they derive raw materials and biotechnologies, so-called because they are derived or copied from living systems (bio-mimetism[1]).
- They disrupt it by waste discharge and emissions, infrastructural development and selective pressures which modify the evolutionary potential of biodiversity.

Up until 2005, the year of the Paris Conference on *"Biodiversity, Science and Governance"*, it was common to hear people say that biodiversity was too complicated an issue for businesses to get involved with, except perhaps as sponsors of some environmental initiatives lead by non-governmental organisations. It was different from the issue of climate change, for which an accounting unit was available, the tonne of carbon. Biodiversity was seen as an exogenous constraint, to be addressed by helping preserve some charismatic species, which would in return be beneficial to the company's reputation.

A lot has changed since 2005!

The *Millennium ecosystem assessment,* published in May 2005, has had a considerable impact, especially in proposing a shared logical framework for analysing ecosystems and developing a typology of "ecosystem services", those services humans derive free of charge from the functioning of ecosystems - the regulation of water and air, the supply of goods, medicines, food, fibres and other materials, as well as religious and cultural aspects of our relationship with living systems[2]. The Stern Report, published in 2007[3], assessed the economic consequences of inaction with respect to climate change by the year 2050 and created quite a stir.

A conference at the Elysée Palace in February 2007, arranged by President Jacques Chirac, assigned the same degree of priority to biodiversity and climate change on the international political agenda and envisaged the need for reform of the ways in which economic activity world-wide is regulated. A proposal was made to create a global ecological organisation for this purpose, which would co-ordinate all UN agencies' policies.

In 2008, the European Commission undertook a similar project to assess the costs of inaction if the 2010 target of halting the erosion of biodiversity is not met (which we know it will not be). The group in charge of this project has released an interim report with instructive preliminary results for businesses[4].

The group began by developing an analytical framework based on the work of the OECD and the *Millennium ecosystem assessment.*

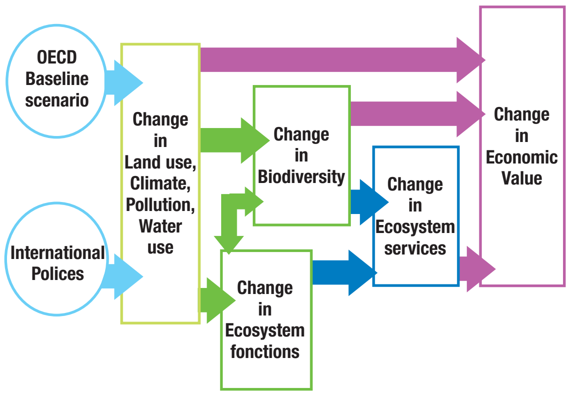

Figure 1 : Conceptual framework of the COPI study

Its initial results, although expected to evolve, are fraught with significance: the degradation of ecological services may represent as much as 7% of world GDP in 2050, or 13,938 billion Euros **a year.** These figures are sufficiently troubling that more detail is presented in the table below, taken from the preliminary COPI report.

TABLE 1: ANNUAL LOSS IN 2050
THE VALUE OF ECOSYSTEM SERVICES THAT WOULD HAVE BENEFITTED MANKIND HAD BIODIVERSITY NOT BEEN LOST & REMAINED AT 2000 & 2010 LEVELS.

	Value of Ecosystem service losses - Annual Billion (10^9) EUR lost							
	Fuller Estimation		Partial Estimation		Fuller Estimation		Partial Estimation	
Area	Relative to 2000 Billion €	Relative to 2010 Billion €	Relative to 2000 Billion €	Relative to 2010 Billion €	Relative to 2000 % GDP in 2050	Relative to 2010 % GDP in 2050	Relative to 2000 % GDP in 2050	Relative to 2010 % GDP in 2050
Natural areas	-15 568	-12 703	- 2 119	-1 679	-7,96	-6.50	-1.08	-0.86
Bare natural	-10	-6	-2	-1	-0,01	0	0	0
Forest managed	1852	1 691	258	213	0,95	0,87	0,13	0.12
Extensive agriculture	-1 109	-809	-206	-141	-0,57	-0,42	-0,11	-0.08
Intensive agriculture	1 303	736	307	143	0,67	0,38	0,16	0.09
Woody biofuels	381	348	55	50	0,19	0,18	0,03	0.03
Cultivated grazing	-786	-1 181	-184	-215	-0,40	-0,60	-0,09	-0.13
Artificial surfaces	0	0	0	0	0	0	0	0
World total (land-based ecosystems)	-13 938	-11 933	-1 891	-1 518	-7,1	-6,1	-1,0	-0.8

The *Millennium ecosystem assessment* identifies four types of capital: manufacturing capital, social capital, human capital and natural capital. At present the bulk of taxation world-wide is applied to manufacturing capital and human capital (through labour). The MEA's experts believe that the present environmental crisis is in large part due to this type of regulation, which encourages the belief that natural resources and ecological services are free. They consider it necessary to plan, starting now, to replace the taxation of manufacturing and human capital with the taxation of all consumption of nature. This switch would act as a strong incentive to conserve nature and increase employment. Since 1988 Sweden has made a commitment to the gradual introduction of ecological taxes *in place of existing taxes, leaving the total tax burden unchanged.* Such a switch may seem unrealistic, given that it would have to be discussed and co-ordinated globally, but it would be one of the surest ways to encourage economic activity in a direction conducive both to the maintenance of biodiversity and to sustainable development. The present publication also concludes with a call for tax reform, logically, though without giving specific details. It was not its purpose.

In late 2005, the Institut français de la biodiversité (IFB) and the think-tank *Orée* began to discuss the possibility of creating a Working Group on biodiversity which would bring together businesses and scientists as well as non-profit organisations and local governments. It was soon agreed that the Group could undertake a two-stage project:

- Stage one: an attempt to identify and evaluate the dependence of businesses on living systems. How much of their raw materials comes from living systems? How much of the technology they use? Beyond that, is it possible to estimate the percentage of sales due to biodiversity? If so, how should we evaluate the contribution of biodiversity in terms of a business's profits and expenses?
- Stage two: *how can we integrate biodiversity into business strategies?* If stage one confirmed the vital importance of biodiversity for businesses, their profits and their future, then an exclusive focus on reducing the impacts of business on biodiversity should be discarded in favour of an innovative approach in which biodiversity becomes an integral part of business strategy.

This approach was a gamble, and was presented as such to the business members of the Working Group. Here we should praise the commitment of the business members, chaired originally by François Laurans of Veolia Environnement, and that of Sylvie Bénard of LVMH, then President of *Orée*, who accepted the risk of failure.

Veolia Environment agreed to contribute to a CIFRE fellowship (PhD Thesis) to fund Joël Houdet, author of this publication. This made it possible to forge links with the ecology laboratory at the University of Paris-Sud 11, his research base, and AgroParisTech, where the thesis is officially registered. Marc Barra, a student in ecology (Master EBE) at Paris-Sud, was also involved in the preparation of this work. The Group has been designated as a "groupe de reflexion" of the Scientific Committee of the Institut français de la biodiversité (IFB).

To make the Group's approach clear to businesses, a number of students from the University of Paris-Diderot 7, supervised by Béatrice Bellini, worked on the assessment of the dependence of the economy on biodiversity, in a "rough and ready" way, across the various industries as defined by the national accounting system. The results are presented in this book. The business members of the Group were then asked to engage in the same exercise themselves. The outcome of this significant work is presented here in the form of "self-assessments", in which the businesses convey their own perception of their relation to living systems, based on a number of criteria. With respect to the integration of biodiversity into business strategies, the challenge, largely sketched out but not yet fully realised at this stage, was to create a *Biodiversity Accountability Framework*, which would be the biodiversity equivalent of the "Bilan Carbone" (greenhouse gas accounting). Financial accounting is not designed to assess and monitor relations between business and biodiversity: this requires the kind of innovation outlined here, to be developed more fully in Joël Houdet's PhD work. No doubt it will constitute a major contribution of his thesis.

Supported by the European Commission, the "Business and Biodiversity" initiative launched in 2005 by the Convention on Biological Diversity (CBD) holds regular meetings on this subject and has called for the adoption of "best practices" to reduce the impact of businesses on biodiversity and promote its preservation[5].

The Working Group behind this book belongs within the context of these initiatives, but has its own particular point of view: the ambition is that its work will go beyond the search for a compromise between conservation and the economy to incorporate biodiversity fully into business strategies, using the language of business itself, that of costs and profits. Ways must be found through which biodiversity can drive development while economic activity can be a means to conserving or increasing biodiversity. This may seem utopian, but it is an appropriate framework for strategic thinking.

Joint initiatives by business associations and the academic world are rare, especially in the field of biodiversity and ecological science. More commonly, businesses ask questions to researchers, who then transfer their knowledge to them; in this case, the work has been shared from the moment the question was formulated. The Orée-IFB Working Group has contributed to giving scientific research credibility in the eyes of business and to spreading the idea in the research community that the future of biodiversity depends on improved relationships with business. This publication *"Integrating biodiversity into business strategies"* will without a doubt increase the desire for co-operation between the world of business and that of research.

Several participants in the Working Group, from both the business and research sides, have played an important role in the discussions of biodiversity at the Grenelle de l'environnement. The Group has also played a part in the inclusion of businesses in the Strategic planning committee of the new Fondation française pour la recherche sur la biodiversité (FRB), which became the successor of the Institut français de la biodiversité in March 2008.

Research on biodiversity at the European level is coordinated by the European platform for biodiversity research strategy (EPBRS), which meets every six months at the invitation of the EU President's office. The EPBRS has chosen the theme of "Business and Biodiversity" for its meeting in Paris in November 2008. As part of this meeting and with France as President of the European Union, *Orée* and the Fondation française pour la recherche sur la biodiversité are organising a major "encounter" on this topic. The Working Group sees this as a sign of its success at the European level and as an opportunity to compare its work with current thinking on the relations between business and biodiversity, in Europe and around the world.

Has the *Orée*-IFB Working Group's gamble succeeded? That is up to the readers, and especially the business members of the Working Group, to decide. The authors of this preface would like to express their

gratitude to these businesses for their confidence in the Group during the past two and a half years, and for their ongoing commitment to it.
In the research community, it has certainly proved a success, as illustrated by the endorsement of the work by the Fondation française pour la Recherche sur la Biodiversité. To signal its institutional continuity with the Institut français de la biodiversité, the FRB has asked that its logo appear on the book.

Ghislaine HIERSO, President - *Orée*

Nadia LOURY, Director - *Orée*

Mathieu TOLIAN, Chair of the Working Group, Direction of environmental performance, Veolia Environnement

Michel TROMMETTER, Research director - INRA

Jacques WEBER, Research director - CIRAD, Director - IFB and Co-chair of the Working Group

(1) See among others Pour la Science, September 2008.
(2) http://www.millenniumassessment.org
(3) http://www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/stern_ review_Report.cfm
(4) http:///ec.europa.eu/nature/biodiversity/economics/index.en_htm
(5) http://www.cbd.int/business

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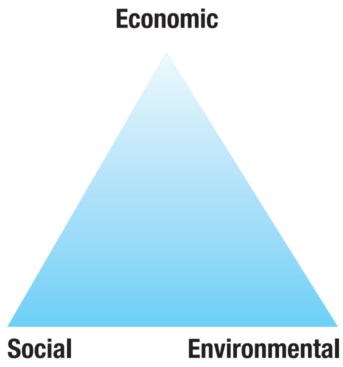


Founex 1971

Since Decision VIII/17 of the Eighth Meeting of the Conference of the Parties (COP 8) to the Convention on Biological Diversity (CDB), held at Curitiba in March 2006, businesses have been invited to contribute actively to international goals for biodiversity. They face several difficult issues, including:

- Taking into account the equitable sharing of the benefits of renewable resources derived from biodiversity
- How to contribute to the conservation and sustainable use of biodiversity
- Translating international goals for biodiversity into their everyday strategies and operations.

The Portuguese Presidency of the European Union has chosen to make the European initiative on business and biodiversity an environmental priority. Its commitment was formalised at the conference on "Business and Biodiversity" in Lisbon in November 2007. The contribution of the world of business to halting the loss of biodiversity by 2010 was again central to discussions at an event held on 2 and 3 April 2008 in Bonn, in parallel with COP 9 of the CDB. Faced with the urgency of the situation highlighted by the Millennium ecosystem assessment (2005a) and confirmed by the interim TEEB report (2008) bearing on the costs of inaction with regard to biodiversity, how are we to shorten the period of discussion needed to institutionalise the challenges of climate change so as to "team up with life", in the words of Robert Barbault?

Reconciling economic activity with biodiversity requires both mobilising businesses and creating new tools. In February 2006 the Institut français de la biodiversité (IFB) and the think-tank *Orée* founded a Working Group on *"how to integrate biodiversity into business strategies".* The company Veolia Environment has made a significant contribution to this Working Group by funding a CIFRE fellowship (PhD thesis). Major companies, small and medium businesses, local governments, scientists and non-profit organisations held quarterly meetings to discuss the methods to be adopted or developed so as to reintegrate economic activity into biodiversity. This guide for *"Integrating biodiversity into business strategies"*, which is largely the result of their efforts, is divided into four sections.

1. The first section introduces the concept of biodiversity from the scientific and business points of view. The primary difficulty in integrating biodiversity into business strategies is to understand exactly what is meant by this concept, now in common use. Next, the Working Group's methodology for analysing the direct and indirect interactions between businesses and biodiversity is highlighted. This concerns the assessment of levels of direct dependence of industries on living systems and the construction of a *Business and Biodiversity Interdependence Indicator* (BBII).
2. The second part of the publication is a collection of self-assessment reports. Compiled from assessments using the criteria of the BBII, they present the image which various companies and local governments have of their own interdependence with biodiversity. Their work confirms that the economy as a whole interacts, directly and indirectly, with living systems.
3. Building sustainable partnerships between business and biodiversity is the challenge addressed to society. The third section thus focuses on analysing more precisely the nature of the influence

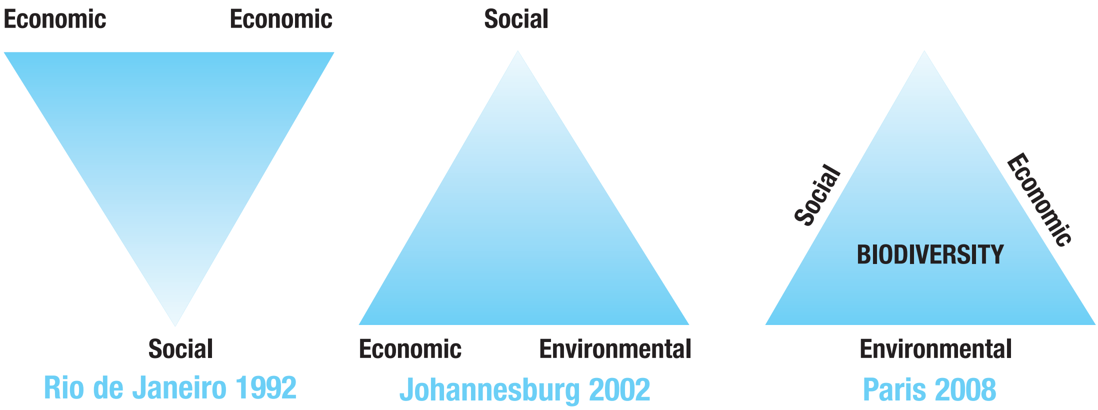


Figure 2 : The evolution of the hierarchy of issues, from Founex to Paris. Biodiversity underpins the interactions between social, economic and environmental issues (adapted from Weber, 2002b).

of business on the evolution of living systems; that is, clarifying the nature of the co-evolution dynamics of businesses and ecosystems. A new model of development is proposed to economic agents, and its challenges, constraints and opportunities are underlined. Simple rules are to be defined and new methods developed for directing interacting ecosystem and socio-economic systems towards the co-viability of biodiversity and businesses. We thus present the *Biodiversity Accountability Framework*, an accounting system designed to account for the relationships between organisations and living systems. In order for its application to be profitable, and for businesses to take full ownership of this approach, we next look to opportunities within current modes of regulation.

4. The final section includes ten innovative initiatives for biodiversity around the world. These brief articles are closely linked to the world of business and provide some answers for building a common path towards the co-viability of biodiversity and businesses.

The meeting of the European platform for biodiversity research strategy (EPBRS) in November 2008 in Paris will focus on "business and biodiversity". It will offer an opportunity to showcase this work and compare it with the discussions and projects under way in Europe and around the world.

SECTION 1
BIODIVERSITY AND BUSINESS: DETERMINING THEIR DIRECT AND INDIRECT INTERCONNECTIONS

1.1 BIODIVERSITY'S CHALLENGES TO SOCIETY

1.1.1 Breaking down the boundaries between the sciences and the globalisation of discussion

Discussion of the diversity of living systems has become globalised at both the scientific and political levels. For quite some time biologists, ecologists, geneticists, palaeontologists and physiologists have perceived the living world as characterised by diversity, but the term "biodiversity", which began to appear in scientific discussion prior to the 1992 Rio Conference, has only recently entered everyday use (Barbault and Chevassus-au-Louis, 2004). We may be witnessing a genuine revolution in the world of scientific research, manifested, as in the newly created field of the ecology of health, in a gradual breaking down of the boundaries between the different disciplines and a cross-cutting, transverse approach to solving scientific problems.

Biological diversity, or biodiversity, refers to **the dynamics of the interactions between organisms in environments subject to change.** We speak of the fabric of the living world, developed over billions of years, whose component parts are *interdependent* and *co-evolving.* Biodiversity constitutes the engine which drives the ecosystems[1] of the biosphere[2], and refers specifically to:

- The genetic diversity and variability within each species,
- The diversity and variability of species and their forms of life,
- The diversity and variability of interactions between species and of the ecosystem processes directly or indirectly generated by living organisms.

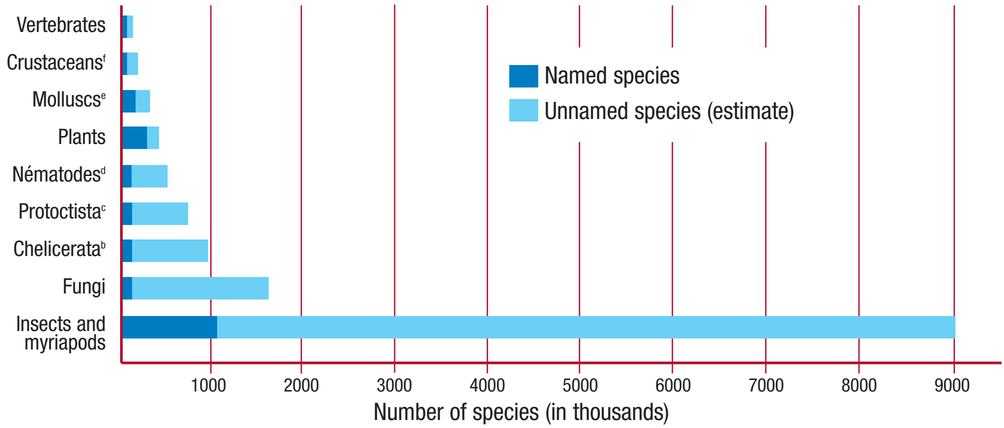
"In nature as in the economic world, there is **neither balance nor imbalance;** *there is merely movement, variability and inertia"* (Weber, 1996).

The second phase of globalisation of the discussion of diversity in living systems expands on and redirects the first phase. Biodiversity is taken beyond the traditional sphere of scientific analysis, to be reconceptualised on the social level (Perrings and Gadgil, 2002). In this context, the Convention on Biological Diversity[3], referred to as the CBD in what follows, considerably broadens the **responsibilities of human societies.** Since the adoption of its text in 1992, these responsibilities have come to include the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits it generates or may generate in future. Taking these considerations into account concerns the social, economic and political construction of the issue of biodiversity (Aubertin, *et al.*, 1998).

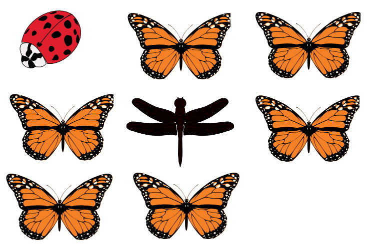
(1) Ecosystems are defined as dynamic biological and physical wholes, capable of self-regulation and governed simultaneously by the laws of thermodynamics and of evolution (Abbadie and Lateltin, 2004).
(2) The biosphere is the global, self-sustaining ecosystem which includes all living things and their relationships, both to one another and with the hydrosphere (water), the atmosphere (air) and the lithosphere (rock), in a metabolism which continuously affects these three spheres by modifying, storing or recycling them. There is only a single living planetary system, and its building-block is DNA (Dawkins, 1989).
(3) www.cbd.int/convention/convention.shtml

Box 1:
How can we comprehend and quantify the diversity of living systems?

What criteria or indications should we adopt to take it into account ? Biodiversity is a remarkably rich concept which throws into relief the depth of our ignorance. Its richness is illustrated below by means of a few examples.



We have only a rough estimate of the number of species which inhabit the planet (Millennium Ecosystem Assessment, 2005a).



Example 1: Three species

Example 2: Two species

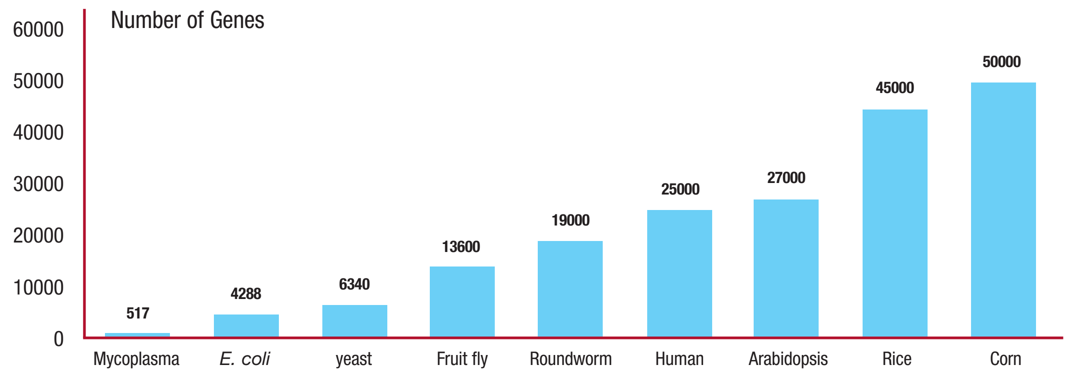
Example number one presents greater species richness than example number two (adapted from Purvis and Hector, 2000). However, in the case of number two there is a higher probability of coming upon different species: that is, there is a one in two chance of finding either an ant or a butterfly. In example number one, the probability of finding a dragonfly or a ladybird is only one in eight. This helps to explain the difficulties encountered in estimating the total number of species in the biosphere. Some may be naturally rare and difficult to observe. They may also inhabit inaccessible environments, as in the case of the great number of organisms living 2500 metres below the ocean surface in the vicinity of underwater hot springs whose temperature can be as high as 350° C.

1.1.1

Example 1

Example 2

Taxonomically speaking, there are six species in each of these examples. However, the second example is more interesting from the point of view of morphological difference and the roles or functions of species within ecosystems.



The size of its genome is not directly proportional to an organism's complexity. An ecosystem includes many factors which may affect the formation and functioning of organisms, and genes are only one factor among others (Pouteau, 2007). We thus speak of an epigenetic landscape[4].

Today, we know that the biomass of the bacteria living in temperate woodlands is vastly greater than that of higher organisms such as plants and vertebrates. In other words, a great deal of biodiversity is invisible to the naked eye.

(4) This concept was introduced by Conrad Waddington.

1.1.1

Box 2:
Biodiversity also includes …

… the interactions between different organisational levels, from that of genetic and species diversity to that of the rural, urban or natural areas in which we live. Ecosystems are organised into extensive landscapes whose diversity owes as much to the effects of erosion, produced by changing climatic conditions and the varying nature of rocks, as to the living organisms which interact, exchange matter, energy and information, compete, co-operate and cohabit. These **underpin the evolution of human populations** and of their modes of organisation.

The resulting variety of ways of life and cultures is expressed through the diversity of languages[5] and religious beliefs as well as foodways, development choices, practices and techniques of land use and resource use, arts and traditions, which vary across space and time (Barbault, 2006; UNESCO, 2008). This diversity of cultures and ways of life in turn relates to the diversity of the ecosystems in which cultural and biological diversity exist in a reciprocal relation. The behaviour of human societies is one component of the evolution of biodiversity within the biosphere (Chevassus-au-Louis, *et al.,* 2004). Article 8 of the CBD on ethno-diversity thus addresses the need to take local knowledge into account in order to accomplish the goals of the Convention.

(5) George Orwell, in his classic *1984,* understood the vital importance of linguistic diversity. The ultimate edition of the dictionary of Newspeak, from which all "useless" words were eliminated, was intended to make all undesirable modes of thought impossible.

1.1.2 Biodiversity ensures the provision of ecosystem services

Our daily lives depend on the totality of the earth's ecosystems, and not merely on the agricultural and marine systems from which we derive most of our food. Terrestrial and marine ecosystems, either in their natural state or as modified by human activities, contain with many useful renewable resources, including domesticated and wild mammals, wild or farmed fish, grains, fruits, wood, cosmetic ingredients of all kinds and fibres for textiles. These resources, all made possible by biodiversity, have long been the objects of economic transactions (OECD, 2005). In addition to resources like these, which we exploit deliberately, we benefit freely from many other ecosystem services, including support services, regulatory services and cultural services (Daily, 1997; Millennium Ecosystem Assessment, 2005a[6]).

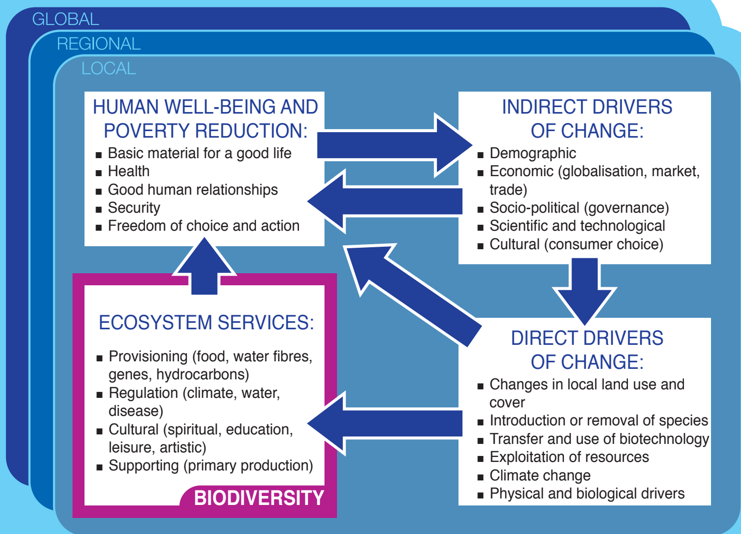


Figure 3 : Biodiversity as central to ecosystem services and to the dynamics of the interactions between socio-economic and ecological systems (Millennium Ecosystem Assessment, 2005a, pp. 13-14).

Once assumed to be inexhaustible and readily accessible, these ecosystem services are today seriously threatened by the increasing erosion of biological diversity (Millennium Ecosystem Assessment, 2005a; OECD, 2005). Still largely left out of economic analysis and traditional growth indicators such as the Gross National Product (GNP), these services are in fact closely tied to the diversity of living systems and the dynamics of their interactions. Among very many examples (Tilman, 2005), we can cite in particular:

(6) This is an international programme undertaken to respond to the needs of decision-makers and the general public for scientific information about the consequences of ecosystem change for human well-being, and about

- Forests and phytoplankton, autotrophic[7] organisms, which produce the oxygen we breathe in and capture the carbon dioxide we emit;
- Plants and micro-organisms, which recycle material from the soil and help to clean up polluted water bodies;
- Pollinating insects, which fertilise the plants on which we rely for agriculture[8] (Olschewski, *et al.*, 2006);
- Birds and bats, which disperse seeds and control phytophagous insects.

Adult acarid *Demodex foliculorum* on human skin.

Box 3: Biodiversity also includes ...

… **micro-organisms** with which **we co-evolve on a daily basis:** the ones in our intestines which help us to digest our food, those which regulate the appearance of our skin by consuming dead skin cells, but also those which cause diseases, including influenza, acute bronchitis or acquired immuno-deficiency syndrome, better known by its acronym AIDS. Since we know that there are considerably more bacteria than human cells in each person's body, what does that tell us about the evolution of the human species? Are humans supporting bacteria or are these organisms shaping us?

Our interactions with all these organisms are not static but constantly evolving. Many pathogens have evolved into new relationships with their hosts, learning to live with them without killing them. For example, some African populations have built up resistance to certain forms of malaria. Understandably, therefore, the research community is increasingly interested in the study of the human metagenome. The goal of the European MetaHIT[9] project, co-ordinated by the Institut National de la Recherche Agronomique (INRA), is to identify the genes and functions of the bacteria of the intestinal flora and to study the effects of this genome on nutrition and health. Current research in epidemiology often shows a lack of consideration of the laws of ecology and evolution which govern living systems (Aron and Patz, 2001). The ecology of health proposes new models and tools for a more integrated, interdisciplinary approach to research into the processes which underlie many diseases and sometimes operate on a regional or global scale (Guégan and Renaud, 2004). The MetaHIT project may in the end turn out to have many industrial and medical applications. It already offers an illustration of the fact that humans are within the diversity of living systems.

(7) Autotrophy is the capacity of some living organisms to produce organic matter by using the sun's energy or inorganic substances such as carbon or nitrogen.
(8) The production of 84% of the species cultivated in Europe depends directly on pollination by insects, in particular bees (more than 20,000 species) and bumblebees. For example, pollination by bees is responsible for 70% of the production of onion seeds; http://eduscol.education.fr/D0110/biodiv_lesdonsdelavie.pdf.
(9) See website: http://www.metahit.eu/metahit/index.php?id=135

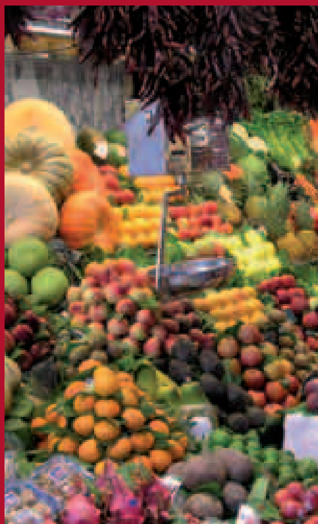
1.1.3 Biodiversity as insurance policy

Biodiversity can be viewed as a **storehouse of responses which living systems can make when faced with ecosystem change,** including climate change (Abbadie and Lateltin, 2004). If the store is reduced due to the pressures of human activity, this will inevitably create a mismatch between the variability of the environment and the range of possible responses by biodiversity. We only view a snapshot image of the diversity of living systems, so that we are tempted to identify many species and habitats as redundant or inessential. But it is **crucial to take account of time scales** for an understanding of the importance of each component of biodiversity and of their **interactions.** We may see this is the case of animal or plant populations whose organisation and distribution vary depending on the climate conditions they have been subjected to over a span of years, centuries or millennia (Parmesan and Yohe, 2003; Pounds, *et al.*, 1999). The roles of species and associations between organisms are constantly changing within ecosystems.

We could take the operations of an investment bank as a parallel: the creation of diversified equity portfolios, that is, portfolios consisting of a variety of stocks which perform independently on the stock exchange, is designed to reduce the risks associated with the market in general and with the specific characteristics of each stock. The same holds true for the relations between humans and ecosystems. To rely solely on one type of land use which appears to be "optimal" at a given point in time, but which irreversibly degrades ecosystems by homogenising their biological components, amounts to a particularly risky gamble which threatens our future. That is why we view biodiversity in all its variety, complexity and variability as **insurance against the unexpected**[10] in the context of global ecosystem change, whether "natural" or produced by humans.

(10) The concept of biological insurance was introduced by Yachi and Loreau (1999). We may also use the terms "adaptive potential" and "sustainable adaptability" (Chevassus-au-Louis, *et al.*, 2004).

Box 4:
Biodiversity on the table: yesterday, today… and tomorrow?



From the genetic and species diversity of food resources …

…and the diversity of agro-systems, biodiversity within farms and fields…

1.1.3

…to monocultures relying on the production of a reduced number of species, particularly vulnerable to pathogens, to provide most of the food supply for human populations.

Today, half of the human food supply is derived from four plants - wheat, maize, rice and potatoes - although we know of nearly 13,000 edible plants, of which 4,800 are cultivated. This is the outcome of the "green revolution" which focuses on grain purity and increasing yield through monocultures and inputs external to agro-systems. Modes of food production and consumption have changed considerably over the centuries. They rest on extremely fragile foundations and are central to debates about food security and ecosystems' health. What risks would global ecosystem changes, associated with the homogenisation of agro-systems, generate for the food we put on the table, in the short, medium and long term? Conversely, what risks for the viability of ecosystems do our choices and models of agricultural production imply? And what issues of social equity arise with regard to both these questions? Research studies show a direct relationship between productivity and biodiversity in agriculture (Hector, *et al.,* 1999). The INRA has shown that devoting 100 hectares to agro-forestry, by planting poplar trees and cereals together in the same field, produces as much wood and grain as 140 hectares in which these plants are cultivated separately. **We must not forget that agro-biodiversity is the insurance policy on which our lives depend.**

1.1.4 Human beings drive the erosion of biodiversity

Understanding the functioning of ecosystems is still fraught with difficulty and uncertainty, whether at the level of an industrial park or a village or at that of the Earth as a whole. Our inability to reproduce artificially the complexity of ecosystem interactions which form the foundation of life on Earth - highlighted by the failure of the Biosphere 2 project[11] (Levrel, 2007) - exacerbates the risks posed by the sixth great wave of biodiversity loss which we face today.

While previous waves of species extinction were the result of major geological events, including extensive volcanic activity, the present one is bound up with the activities of a single species, *Homo sapiens,* which has gradually become dominant over the last two million years (Teyssèdre, 2004). While we, **humans,** from our genetic diversity to the diversity of our cultures and ways of life, **constitute an integral part of biodiversity,** we are also, paradoxically, **directly and indirectly responsible for its erosion and for increasing uniformity.**

This responsibility, which is shared by all economic agents, consists primarily of:

- The degradation and widespread destruction of ecosystems, leading to the homogenisation of habitats over increasingly large areas (Tilman, *et al.,* 2001);
- The excessive exploitation of renewable, living resources (Pauly, *et al.,* 1998);
- The deliberate or accidental introduction of alien species, which can invade ecosystems and disrupt their functioning (Steadman, 1995);
- Global warming, which directly affects the evolution of ecosystems, including the distribution of the species which inhabit them (Convention on Biological Diversity, 2003; Pyke, *et al.,* 2005).

These four direct causes of the erosion of biodiversity operate synergistically, at a constantly accelerating pace. The over-exploitation of species is intensified by the reduction of the size of their habitats. Ecosystem degradation reduces their resistance to invasion by introduced alien species (Kennedy, *et al.,* 2002). Habitat fragmentation, an inevitable consequence of urbanisation, among other types of land use, hampers the migration of organisms which seek to survive and adapt to climate change.

(11) For more information on this project, see: http://www.biospheres.com/

Box 5:
The four primary causes of the erosion of biodiversity, in pictures

Destruction of the boreal forest to prepare for bituminous sand extraction near Fort McMurray, Canada. These development decisions generate habitat fragmentation.

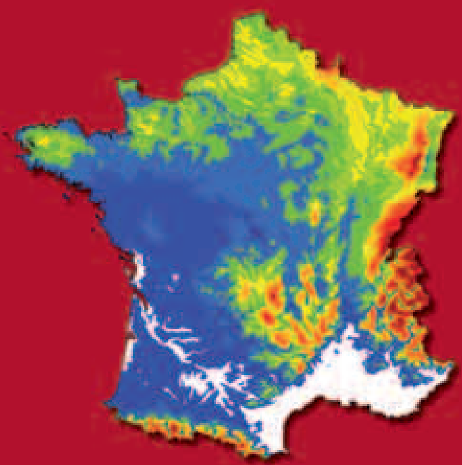
According to the FAO[12] and UNEP[13], fishing activities worldwide are responsible for the increasing depletion of fish stocks. Some techniques are particularly destructive, causing significant declines in populations of non-targeted species, such as albatrosses and sea-turtles, and undersea habitat destruction, such as scraping of the biocoenoses[14] of seamounts, which exhibit very slow growth rates (Cury, 2008).

(12) http://www.fao.org/docrep/003/V5321f/V5321F05.htm
(13) http://www.grid.unep.ch/product/publication/download/ew_overfishing.fr.pdf
(14) The totality of the biological components of an ecosystem.

1.1.4

Caulerpa taxifolia, a green tropical alga, has become an invasive species in the Mediterranean Sea after being accidentally released from the Monaco aquarium. By replacing native organisms, this engineer species could eventually create new ecosystems. The Port-Cros national park organises dives each year for its detection and eradication. Eradication work is feasible only on lightly contaminated areas, since no effective means of dealing with dense invasions have been developed thus far.

The distribution range of the beech tree *(Fagus sylvatica)* in France in 2000 is illustrated by Map 1 above. Map 2 presents a simulation of its range in 2100, assuming that CO_2 emissions remain at current levels throughout the 21st century (Badeau, *et al.,* 2004). Climate change will lead to significant changes in the distribution of many species and in the functioning of ecosystems. While this may be beneficial for some organisms, many others will be doomed to extinction, due to destruction of possible migration corridors (artificial barriers such as roads and monocultures stretching as far as the eye can see), or to the absence of habitats with favourable conditions (species restricted to a few mountain peaks, as is the case for dozens of plant species in South Africa's Cape Province). These changes will have significant consequences for our ways of life, particularly with respect to landscape and the food we eat.



Map 1:
Distribution of beech trees in 2000[15]

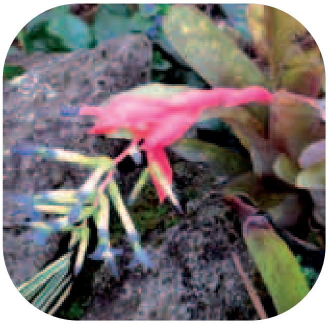
Map 2
Probable distribution in 2100

(15) Project CARBOFOR. Task D1: "Modélisation et cartographie de l'aire climatique potentielle des grandes essences forestières françaises", June 2004. Vincent Badeau (INRA), Jean-Luc Dupouey (INRA), Catherine Cluzeau (IFN), Jacques Drapier (IFN) and Christine Le Bas (INRA).

1.1.5 From the protection of threatened species to a concern for interactions within ecosystems

Laws and regulations relative to biodiversity have been deeply influenced by a reductionist view of living systems, in which diversity is equated simply with the number of species. While this approach has been beneficial for some species threatened with extinction, it nevertheless focuses on the regulation of harvesting and on the "bell-jar" isolation of areas which are often unviable in the long term; *without taking into account either the diversity of associations between species within each habitat or the way in which ecosystems function.* Yet, the health of ecosystems, as exemplified by the state of their biodiversity, is key to current debates, especially since the Millennium Ecosystem Assessment (2005a) highlighted the links between the dynamics of ecosystem functioning and the services human societies derive from them. Following the recent European Directives on Water[16] and Environmental Responsibility[17], we can expect to see **regulatory changes,** on both a national and international level, moving towards a focus on the **health of ecosystems,** *whether these are of natural or anthropogenic character.*

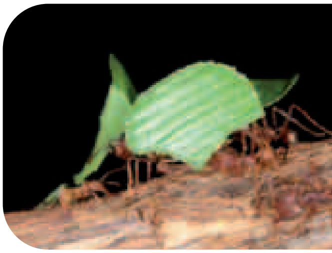
Figure 4 : Co-operation between bryophytes, orchids, trees, lichens, lianas and bromeliads in Costa Rica



Today, biodiversity is used both as a standard and a criterion for evaluation. In the Vanoise National Park in the French Alps, biodiversity has been adopted as a goal in the management of mountain pastures: livestock density is optimised in order to promote an increase in species richness (Selmi, 2006). At the same time, biodiversity indicators are utilised to assess the impacts of human activities, both in the core and surrounding areas of this park. This approach makes it possible to improve policies for the conservation of biodiversity, towards land use planning which takes into account all the organisational levels of ecosystems. The approach is not limited to protected areas: it is gradually being extended to **rural, marine, urban and industrial areas,** for instance via the expansion of the network of Natura 2000 sites (Pinton, *et al.*, 2006) and by the launch of a "green and blue thread" throughout France, following on the "Grenelle of the Environment".
The diversity of interactions between organisms is key to ecosystem dynamics (Barbault, 2006) and to the services that we derive from them (Millennium Ecosystem Assessment, 2005a). For example, lichens are formed by the symbiotic rela-

(16) The Directive of 23 October 2000 adopted by the European Council and Parliament defines a framework for the management and protection of water, organised by major European river basin. This Framework Directive makes the protection of the environment a priority, requiring that the further degradation of water quality be halted and that by 2015 good chemical and ecological status is reached for surface waters, groundwater, transitional waters and coastal waters ; http://europa.eu/scadplus/leg/fr/s15005.htm
(17) See Patricia Savin's contribution, p. 324.

Figure 5 : Leaf-cutting ants of the genus Atta grow funguses on substrates composed of masticated leaves; in return, the funguses produce edible material which the ants feed on.



tionship of two species from different phyla, that is, a unicellular alga or cyanobacterium and a fungus. Often a continuum of relationships exists between interacting organisms, from symbiosis to parasitism, as in the case of the relationship of mycorrhizae with the roots of certain plants[18]. The sea anemone and clown fish and the insects which pollinate plants are among the many examples of mutualistic relationships between organisms.

Organisms with short reproductive cycles are coming to predominate in many habitats, especially in the oceans, where fish are victims of over-fishing (proliferation of jellyfish is an example ; see Cury, 2008). What will be the ensuing consequences in the food chain, both for fishermen and the food on our tables? Another example: global warming is speeding up growth cycles in many forest areas. While this might be advantageous for some types of use of biomass (such as agro-fuels), what does it portend for the future of organisms with longer life cycles, including not only many trees[19] but also species whose ecological niches are associated with centuries-old organisms (such as nocturnal raptors who nest in trunk cavities)? More importantly, what are the implications for the ecosystem services we derive from forests, which are major climate regulators? *Taking biodiversity into account really means focusing on the dynamics of the interactions between organisms in changing environments.*

In view of the acceleration of the processes leading to the erosion of biodiversity, concern is being voiced about the **consequences** of **irreversible change** and of the **loss of interactions**[20] within ecosystems, rather than simply of the loss of species. The latter concern is unfortunately still too often touted by the media and some pressure groups. This is why it is relevant to address more specifically the nature of our interactions with living systems.

(18) Mastering these interactions would significantly reduce the need for fertilisers.

(19) Above a certain level of absorption of CO_2, trees which cannot draw upon the other nutriments which they require become structurally fragile and their life-span is shortened, which in turn increases CO_2 and methane emissions (Granados et Körner, 2002).

(20) Either between species, at the level of trophic networks, or between organisms and bio-geophysical processes.

1.1.6 Reintegrating the economic sphere into biodiversity

A society's system of Values is its system for ordering the universe, the world, objects, beings and the relationships between beings and objects. This overarching typology, unique to each culture, provides the reference system governing the views and attitudes of individuals and groups in the society. Honesty, honour, fidelity, homeland, compassion, as well as the flag and the constitution, are Values in this anthropological sense. ***These Values cannot be sold, given away, lent, or exchanged: they can only be shared.*** *Values in this sense cannot be expressed in terms of willingness-to-pay :* ***these Values are priceless.***

Jacques Weber (2002, p. 10)

From an economic point of view, three main approaches have been proposed for taking biodiversity into account when making development choices:

- *Asking how to integrate biodiversity into the economic sphere leads to putting a price on nature.* One seeks to represent the sum of willingnesses-to-pay as a strong case for action, by playing with rates of extrapolation across space and time and viewing as if it were the result of a market transaction between a seller and a buyer. This would be like confusing the price that someone agrees to pay for the Mona Lisa with the value of the masterpiece (Weber, 2002a), this without considering the costs necessary to its maintenance in the long term. What price can we put on the bacteria which digest the food in our intestines, the poppies and skylarks in our fields, or the parasites which cause malaria? It is a safe bet that the price would vary from person to person, and would depend on the moment the question is raised. Surveys would have to be carefully set up and orentiated! Which population would you choose? A group composed of members of various environmental NGOs? An audience made aware of the challenges posed by malaria on the occasion of the next World Health Day? Households affected by the next stock market crash?

- **Comparing different development scenarios by way of a cost-benefit analysis may turn out to be more effective.** When New York City began to plan the construction of a new water treatment plant, it did not attempt to put a price on nature. Instead, it estimated the **cost to restore the ecological functions** of its degraded watersheds, which proved to be very much cheaper than the construction and operation of the proposed plant (Chichilnisky and Heal, 1998).
- Lastly, Nicholas Stern proposed a novel approach in his 2006 report on the economics of climate change: **separately calculating the costs of climate change and the costs resulting from the failure to act.** When economic decision-makers believe that some action or change of behaviour is expensive, they can often be made to change their minds by a demonstration of what it would cost not to act or not to make a decision. The team led by Pavan Sukhdev[21] is now adopting this approach, so as *to compare the economic benefits of biodiversity with the costs associated with its erosion, the costs of inaction and, lastly, the costs of its conservation.* For example, trying to estimate the economic and social costs of deforestation of the Amazon rainforest amounts to asking what it would cost to reconstitute this "lung" of the biosphere in all its complexity[22].

It is neither appropriate nor necessary to put a price on biodiversity in order to ensure its viability. Ecosystems condition our economic activities and ways of life, which in turn modify these ecosystems, their functioning and their biological components. Human populations and biodiversity thus cohabit within one single system. We need to recognise that biodiversity is *our primary insurance policy in an uncertain world where change and ecosystem surprises are the norm*[23], which means asking *what we need to do to insure ourselves against uncertainty and preserve our future.* We must **move away from the approach of integrating biodiversity into the economic sphere,** *towards that of reintegrating the economy into biological diversity.* Given the urgency of the situation, how can we telescope the period of discussion needed to institutionalise climate change issues, so as to reconcile the areas we live in and exploit with the diversity of living systems? It is not only a question of stimulating economic agents to take action - with businesses at the forefront - but also of creating new tools for mutualistic models of development between biodiversity and human populations, so that to *"team up with life"* (Barbault, 2006).

(21) http://ec.europa.eu/environment/nature/biodiversity/economics/index_en.htm
(22) In particular, to recreate its biodiversity and its ecosystem dynamics and functions.
(23) There is nothing but variability, instability and uncertainty in nature. The "balance of nature" is a myth to which we are much too attached (Holling and Gunderson, 2002).

1.2
BIODIVERSITY FROM A BUSINESS PERSPECTIVE

1.2.1 A source of risk and opportunity

Beyond the financial and social risks they have traditionally had to cope with, businesses must now face a new one, "environmental" risk. Taking account of this kind of risk requires that businesses modify their perspective. While we now accept that decisions taken today will have an impact on future generations, it is not necessarily the case that those who take the risks today will suffer the consequences tomorrow. How should we assess the environmental liabilities of corporations and their subsidiaries with respect to mergers and acquisitions (Crédit Agricole Chevreux, 2006)? Intergenerational concern for the elderly, given concrete form in the old age pension system, must now be supplemented by a new form of intergenerational concern for future generations. Currently expressed primarily as the "metric ton of carbon equivalent" of climate change, this new risk demands an economic system based on a longer-term vision. For businesses, this means identifying and assessing the risks and impacts of their activities on ecosystems, including in financial terms, with the goal of reducing them (Backer, 2005; Reynaud, *et al.,* 2006).

At the present moment, a real awareness of the links between business and the erosion of biodiversity is of concern mainly to large corporations and multinationals, the businesses most visible to the general public and those directly involved with living systems. These are the ones most likely to be subject to pressure from stakeholders, non-governmental organisations, local residents and corporate social responsibility (CSR) rating agencies. Since decision VIII/17 was taken in Curitiba in March 2006 at the COP 8 of the Convention on Biological Diversity[24], the business world has been asked to contribute actively to the objectives of the CBD[25] and must address several difficult issues, including:

- how to share out equitably the benefits derived from biodiversity,
- how they contribute to the conservation and sustainable use of biological diversity,
- how international goals with respect to biodiversity can be implemented in their strategies and daily activities.

(24) See the website of the Secretariat of the CBD: http://www.cbd.int/decisions/?m=COP-08&id=11031&lg=0
(25) Especially via commitments made at international events such as the 'Business and Biodiversity' European Conference held in Lisbon in November 2007.

1.2.1

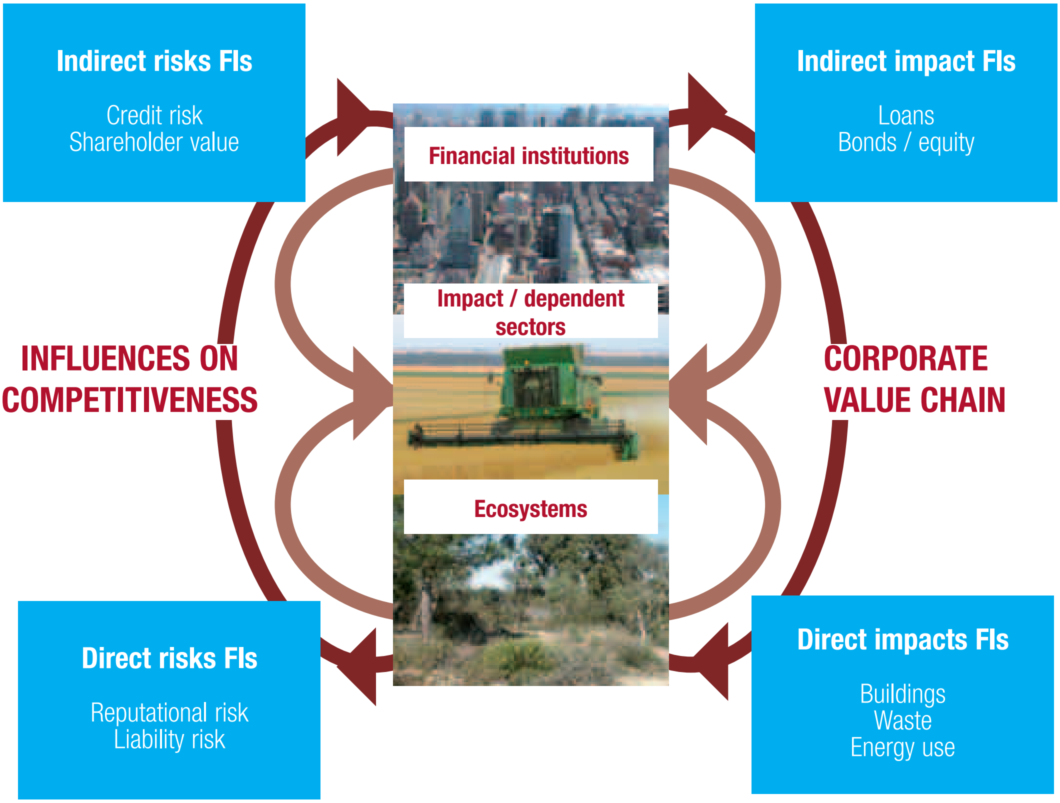


Figure 6 : Connections between the world of finance, economic activities and ecosystems (adapted from Porter and Kramer, 2006).

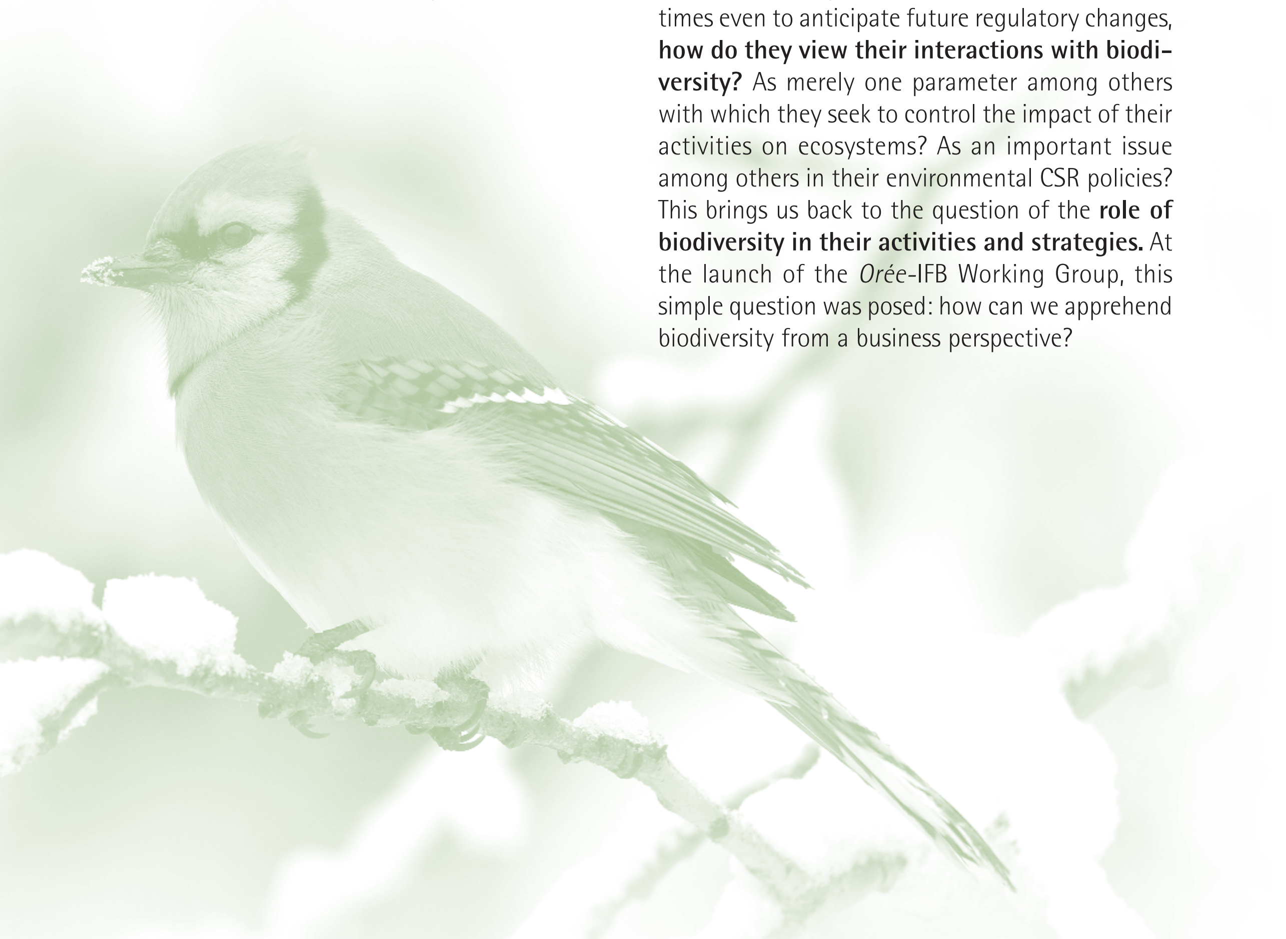
The legal aspects of environmental risk are complex, and the concept of "biodiversity risk" is particularly difficult to comprehend. While one of its elements is fairly objective, that is to say the *probability* and the *severity* of *damage*, it also contains a subjective, cultural element, that is to say the *perception* and *acceptability of risk* (Chevassus-au-Louis, 2007). Systematic opposition between the business and scientific or non-profit communities is no longer the norm (Barbault, 2006), but some topics continue to raise problems and call for more genuine discussion - ongoing public, transparent and contradictory debates - when it comes to making development choices. In short, *the complexity, variability and uncertainty associated with biodiversity are sources of both risks and opportunities* (F&C Asset Management, 2004; Millennium Ecosystem Assessment, 2005b; Mulder, 2007):

- **Regulatory** risks concern, for instance, fiscal issues and environmental impact studies performed in the course of requesting development authorisation[26]. Opportunities exist when *new legislation relative to biodiversity can be anticipated*, particularly in the form of avoidance of additional costs and access to new markets.
- Risks connected with **company image** and **reputation** may arise in the context of access to new markets and of relationships with customers and shareholders who have become more aware of ecological issues. Building sustainable partnerships with stakeholders and identifying common goals can contribute positively to a business's goodwill.
- Risks associated with the **availability** and **cost of raw materials,** both organic (such as biomass) and inorganic (such as aggregates derived from limestone or igneous rock), must be taken into account in cost management and production processes. Reducing the consumption of these resources and managing the areas they come from in an ecologically sound way may be particularly advantageous.
- Risks attached to **access to capital,** resulting from the other risks just listed, affect primarily the business sectors which have the greatest impacts on biodiversity. Such companies risk the exclusion of their shares from the investment portfolio of certain investors and may be subject to increased insurance costs or loan interest rates. Conversely, companies with the best CSR performances may have access to financing at subsidised rates and may appeal to investors with a commitment to the environment.

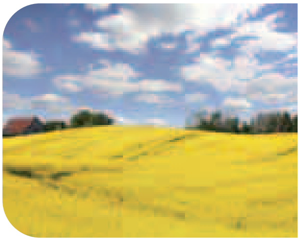
(26) In France, this takes place primarily through regulation relative to the Installations *Classées pour la Protection de l'Environnement* (ICPE) and the law of 1976 bearing on the protection of nature.

1.2.1

We should bear in mind that regulatory risks and image risks may have a decisive effect on a business's right or capacity to pursue a course of action. According to the recommendations of the Global Reporting Initiative[27], whenever a business has a material impact on ecosystems this ought to be reported. In France, the law on New Economic Regulations of 2001 (art. 116) stipulates that all French companies listed on the Paris stock exchange must include in their annual reports information about how they take into account the social and environmental consequences of their activities. However, the information about biodiversity in the CSR reporting by the several hundred companies concerned is still anecdotal, not to mention that there are no precise rules about what information to communicate, no independent audit of the accuracy and quality of the information, nor even penalties for failure to comply with the law. If businesses are trying to comply with the regulations and sometimes even to anticipate future regulatory changes, **how do they view their interactions with biodiversity?** As merely one parameter among others with which they seek to control the impact of their activities on ecosystems? As an important issue among others in their environmental CSR policies? This brings us back to the question of the **role of biodiversity in their activities and strategies.** At the launch of the *Orée*-IFB Working Group, this simple question was posed: how can we apprehend biodiversity from a business perspective?



(27) This is a non-governmental organisation which regularly produces tools and methodologies by businesses for environmental, social and economic reporting: http://www.globalreporting.org/Home.



Box 6:
Agro-fuels: which models and development decisions are appropriate in the face of ecological challenges and food needs?

Agro-fuels are produced via biotechnology techniques using organic, renewable (non-fossil) materials. They can be manufactured in a wide variety of ways : solid fuels include charcoal ; oil and alcohol can be made by fermenting sugar or hydrolysed starch while gas fuels (such as dihydrogen and methane) can be produced from plant or animal biomass. With the support of many governments, the cultivation of energy crops is expanding rapidly throughout the world (SCNAT, 2008).

Beyond the controversies regarding the energy efficiency of agro-fuel production, which vary depending on countries, crops and techniques, the growing pressure on land use has not only impacted biodiversity negatively but has also led to food crises in countries of the South. Recent reports from the Organisation for Economic Cooperation and Development (OECD)[28] and the Food and Agriculture Organization (FAO)[29] are worded very critically: they cite, for example, the massive use of fertilisers and pesticides, the cultivation of fallow land in Europe, and especially the speeding up of deforestation in many tropical countries to make room for monocultures. The longer-term harm done to ecosystems can only be presumed at this stage.

We need to avoid conflicts between climate-related challenges, the viability of biodiversity and the viability of human populations. Under certain conditions, synergies are possible between energy production, biodiversity and improved value creation for local communities (SCNAT, 2008). We must take into account the repercussions for biodiversity when certification systems for agro-fuels, based on environmental audits, are developed. For instance, using agricultural by-products and waste to produce energy might be appropriate as long as we ensure that soil fertility and biodiversity do not suffer in consequence.

(28) http://www.oecd.org/dataoecd/2/40/39743323.pdf
(29) http://www.fao.org/newsroom/fr/news/2007/1000620/index.html

1.2.2 Understanding the needs of business

Managing biodiversity means focusing primarily on the management of interactions among humans with respect to nature, first at the level of regulation and control of access to resources, then at the level of the decision-making process, whether imposed from elsewhere or negotiated and contractual.

Jacques Weber (1996, p. 1-2)

When businesses take biodiversity into account, whether at the level of their industrial sites or with respect to their strategies, they often do so unconsciously and indirectly, relying on tacit knowledge or the personal commitment of some of their employees. At best, this is a newly emerging approach, now in the process of being addressed formally by the businesses which are most proactive with respect to their social and environmental responsibility. Current environmental management systems, based on a continuous improvement approach, unfortunately cannot yet stand up to the challenges posed by ecosystems which are becoming ever more degraded. The performance indicators utilised only *partially reflect the components and dynamics of ecosystems:* that is, they refer primarily to the management of resources (for instance water consumption) and the control of emissions and effluents.

For businesses, the first difficulty is the intrinsic complexity of biodiversity, which gives rise to the problems encountered in **defining clear objectives, constructing sets of suitable indicators** and **decision-making** (Houdet and Loury, 2007). Obstacles soon appear when there is a need for practical action in support of biodiversity, since measuring results often requires a long-term commitment (Delannoy, 2006; Houdet and Loury, 2007). Despite all the advances in ecological engineering, expertise is not yet widespread and is mainly limited to case studies of large infrastructure projects or major industrial sites.

On the ground, developers, designers and managers of industrial sites are confronted daily with thorny decisions. For example, what taxonomic groups should be chosen for monitoring biodiversity when budgetary resources are limited? What initial state should be adopted as the reference for managing and compensating for ecological impacts? How to reconcile the often contradictory needs and expectations of stakeholders, for instance generating hydroelectric power – *a renewable souce of energy* - while at the same time conserving aquatic biodiversity? With respect to procurement, what stimuli could encourage the adoption of different production methods by suppliers, especially if the company is negotiating from a position of weakness with the supplier? How to implement effective, systematic action plans and, above all, how to bring about real changes of perspective among the teams concerned towards technological and organisational innovation?

If businesses are to be on the front line in the attempt to reintegrate the economic sphere into biodiversity, it is essential to go beyond general recommendations in dealing with such questions. What role can businesses play in the fight against the increasing erosion of biodiversity? As with a growing number of other cases, such as the consequences of climate change or public health problems, *we cannot address uncertainty by a probability distribution:* we are faced with a situation which is genuinely uncertain, not merely characterised by risk (Henry, 1974; 2005). To respond to the demands of businesses, the *Orée*-IFB Working Group has agreed that there is a need **to move beyond the traditional approach,** which is **confined to analysing and managing the impacts of business on biodiversity.** It sought to *identify ways in which biodiversity can play a part in shaping business strategies.* In the first meetings of the Working Group in 2006, a starting-point and a common vocabulary were defined. It allowed us to get our first sense of what each member thinks about biodiversity so that to assess its interconnections with business. We found that companies view biodiversity as :

- A **going concern issue,**
- A source of **raw materials, technologies** and **products,**
- A source of **profits,**
- Linked to **private production costs,**
- Linked to **social costs,** both in terms of possible damages to ecosystems and their additional costs incurred by human communities.

1.2.3 Economic sectors' direct dependence on living systems

The Working Group hired students to test a methodology for **categorising the various industries,** using the classification of French industries on the INSEE website[30], in terms of their degree of **direct dependence on living systems**[31]. An industry is understood as a group of homogeneous production units which manufacture products or provide services belonging to the same type of economic activity as defined by INSEE. The method used was designed to be simple so as to make businesses aware of the issues and initiate a process of participatory research.

The criteria adopted

For its analysis of the **direct links between industries** and the **living systems they depend on,** the Working Group adopted four evaluation criteria:

- The **raw materials** derived from living systems to be used in the manufacture of goods and provision of services in the industry in question, such as cotton for the clothing industry;
- The **technology** derived from living systems to be used in the industry in question for the manufacture of goods and provision of services, such as lactic fermentation for yoghurt and yeast (alcohol) fermentation for bread;
- The **impacts** on biodiversity resulting from the industry's activities (only direct impacts such as habitat destruction are subjected to analysis at this stage);
- The **share of sales** related to biodiversity.

Assessing the relationship between each criterion and industry

An assessment was carried out independently by each student for each of the industries in question. A relationship with the living world, calculated as a percentage, was estimated for each of the four criteria adopted – "raw material", "technology", "impacts" and "sales". After tabulating all the assessments in an Excel spreadsheet, an average and a standard deviation for the percentages were calculated in order to identify significant variations across the students' assessments. The industries were then sorted by ascending standard deviation in order to assess the consistency of the ratings. In cases of major divergence between the different percentages, the assessments were discussed further and the average adjusted. Two complementary analyses of industries were performed:

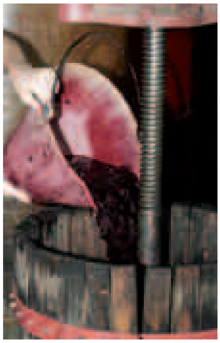
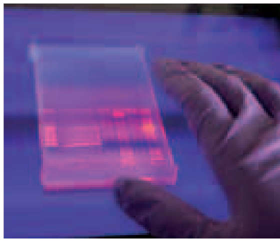
- Analysis by single criterion.
- Combined analysis for all four criteria.

Analysis by single criterion

An average rating for each of the criteria enables the identification of industries with the greatest direct dependence on biodiversity.

(30) http://www.insee.fr/fr/nom_def_met/nomenclatures/naf/pages/naf.pdf
(31) Work carried out in 2006 by four students of the Master SGE - Alloin J.P., Biasini B., Lecomte A. and Pilon M., supervised by Béatrice Bellini, Nadia Loury, Michel Trommetter and Jacques Weber.



Box 7: What is biotechnology?

Generally speaking, by biotechnology we mean any technique derived from biodiversity. Interactions between organisms can count as biotechnology even if they are not of direct benefit to humans. The OECD[32] has chosen to adopt an anthropocentric viewpoint, defining **biotechnology** as "the application of science and technology to living organisms, as well as parts, products and models thereof, to alter living or non-living materials for the production of knowledge, goods and services". It is used especially in research and in the manufacture of materials for the pharmaceutical, chemical and food industries. The following list is indicative and not exhaustive:

DNA / RNA: genomics, pharmacogenomics, gene probes, genetic engineering, DNA / RNA sequencing/synthesis/amplification, gene expression profiling, and use of antisense technology.

Proteins and other molecules: sequencing/synthesis/engineering of proteins and peptides (including large molecule hormones); improved delivery methods for large molecule drugs; proteomics, protein isolation and purification, signalling, identification of cell receptors.

Cell and tissue culture and engineering: cell / tissue culture, tissue engineering (including tissue scaffolds and biomedical engineering), cellular fusion, vaccine/immune stimulants, embryo manipulation.

Process biotechnology techniques: fermentation using bioreactors, bioprocessing, bioleaching, biopulping, biobleaching, biodesulphurisation, bioremediation, biofiltration and phytoremediation.

Gene and RNA vectors: gene therapy, viral vectors.

Bioinformatics: construction of databases on genomes, protein sequences; modelling complex biological processes, including systems biology.

Nanobiotechnology: Applies the tools and processes of nano / microfabrication to build devices for studying biosystems and applications in drug delivery or diagnostics.

(32) http://www.oecd.org/document/41/0,3343,fr_2649_201185_35534441_1_1_1_1,00.html

1.2.3

The "raw material" criterion

The following industries have the highest percentage of dependence on raw materials derived from biodiversity - that is, greater than 75%. The primary industries are particularly concerned by this criterion.

- Agriculture, hunting, ancillary services including livestock breeding, landscape management: 99.75%
- Fishing, aquaculture, ancillary services: 99.75%
- Food industries, including pet food and alcoholic beverages: 99.5%
- Forestry, ancillary services: 98.25%
- Tobacco industry: 94.75%
- Paper and cardboard manufacturing: 94.75%
- Wood industries including manufacturing wooden articles: 75%

The "technology" criterion

The link between industry and technology was particularly difficult to assess. The estimated percentages of dependence were relatively low, with no industry at more than 40%. Further study of existing and potential biotechnologies broken out by industry would be required to generate more realistic estimates of these emerging technologies.

The "impact" criterion

The following industries have the highest direct impact on biodiversity - that is, greater than 80%. They belong to the extractive industries, which are often responsible for the destruction and fragmentation of ecosystems.

- Extraction of coal, lignite and peat: 81.25%
- Extraction of hydrocarbons: 81.25%
- Uranium mining: 81.25%
- Metals mining: 81.25%
- Other extractive industries (including rock, sand and clay, natural fertilisers, salt): 81.25%

The "sales" criterion

The amount of sales directly linked to biodiversity is particularly difficult to estimate. It varies in proportion to the amount of raw materials derived from biodiversity which are used to manufacture the final product, and to the use of biotechnologies in the production of the goods and services to be sold. The industries most concerned are those whose dependence as measured by the "raw material" criterion is the greatest. Three industries stand out under this criterion, with a degree of dependence on living systems of more than 80%:

- Fishing, aquaculture, ancillary services: 88.5%
- Forestry, ancillary services: 86%
- Agriculture, hunting, ancillary services: 84.75%

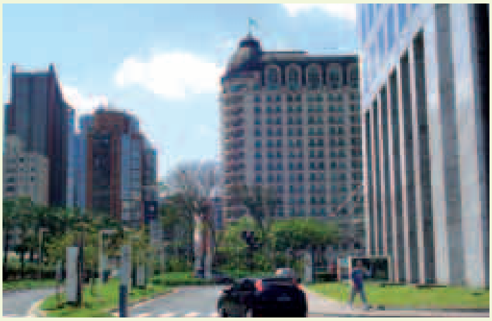
1.2.3

Analysis of combined criteria

In order to present an overall picture of the direct dependence of each industry on living systems, a summary table of averages for each criterion was generated.

TABLE 2: THE FIRST 12 OUT OF A TOTAL OF 62 INDUSTRIES, SORTED IN DESCENDING ORDER BY OVERALL DIRECT DEPENDENCE ON LIVING SYSTEMS

INDUSTRY	AVERAGE "SALES" CRITERION
AGRICULTURE, HUNTING, ANCILLARY SERVICES (INCLUDES LIVESTOCK BREEDING, LANDSCAPE MANAGEMENT)	84,7
FISHING, AQUACULTURE, ANCILLARY SERVICES	88,5
FOOD INDUSTRIES (INCLUDES PET FOOD AND ALCOHOLIC BEVERAGES)	61,2
FORESTRY, ANCILLARY SERVICES	86
TOBACCO INDUSTRY	57,5
PAPER AND CARDBOARD INDUSTRY	58,7
WOOD INDUSTRY AND MANUFACTURE OF WOODEN ARTICLES	48,7
CLOTHING INDUSTRY	46,2
LEATHER AND SHOE INDUSTRY	45
CHEMICAL INDUSTRY (INCLUDES PAINTS, VARNISHES, PHARMACEUTICALS, SOAPS, CLEANING PRODUCTS, EXPLOSIVES, ARTIFICIAL FIBRES)	31,2
RESEARCH AND DEVELOPMENT	37,5
EXTRACTION OF COAL, LIGNITE AND PEAT	20



AVERAGE "RAW MATERIAL" CRITERION	AVERAGE "IMPACT" CRITERION	AVERAGE "TECHNOLOGY" CRITERION	AVERAGE OF AVERAGES
99,7	67,5	21,2	68,3
99,5	48,7	22,5	64,8
94,7	35	38,7	57,4
99,7	28,7	5	54,9
98,2	42,5	1,5	49,9
75	38,7	2,5	43,8
94,75	11,2	1,5	39,1
50	28,7	17,5	35,6
50	43,7	2,5	35,3
28,7	60	16,2	34,1
45	21,2	30	33,4
17,7	81,2	10	32,3

1.2.4 Biodiversity underpins economic activity

Through this initial research the *Orée*-IFB Working Group confirmed that *many industries are directly dependent to a considerable degree on living systems,* as judged by at least one of the four adopted criteria. While these are still only rough estimates, they show that **biodiversity underpins the development of a significant number of businesses.** *Once we start thinking in terms of dependence on biodiversity,* two points emerge:

- When the *degree of dependence is substantial,* managing impacts on biodiversity *cease to be an external constraint* on the business, which can consider it as a normal cost, offset by **normal profits:** it becomes an integral part of the business's standard operations.
- This suggests that we need **to develop a new accounting system,** complementing the current one, *for reporting on interactions between businesses and living systems;* bringing to the fore a different understanding of human activities within biodiversity.

Biodiversity would thus be taken into account *within a business's standard system of cost-benefit analysis.* **It wouldn't anymore be treated merely as a matter of impacts,** *nor as an external constraint on an organisation' functioning.* Raising the issue of the costs and benefits associated with the reintegration of the economic sphere into biodiversity would come to be seen as a normal issue from a business's perspective. Yet, by using these four criteria, the indirect links between businesses and biodiversity remain invisible. Many industries with major direct or indirect impacts on ecosystems (greenhouse gas emissions) have no direct connections with living systems: for example, the transport industry, the automotive sector, manufacturing of machinery and equipment, the construction industry, as well as the banking, insurance and finance industries which underpin the workings of the economy. Biodiversity, as a key driver of ecosystem change, is indirectly impacted whenever the functioning of those ecosystems is impaired. In recognition of this fact, the businesses which participated in the Working Group voiced two complementary proposals:

- **Indicators should be developed for assessing and managing the interactions between biodiversity and businesses;**
- **Simple rules should be devised for dealing with the complexity and uncertainty characteristic of biodiversity.**

Faced with these conclusions and needs, the Working Group decided to pursue the issues in question. How can a business's **indirect dependence on biodiversity** be made visible? How can we identify **occurrences of interdependence,** that is, *reciprocal relationships between changes in biodiversity and changes in the activities of a business?* The business world does not change independently of the natural world: biodiversity underpins economic activity, which in turn generates changes in biodiversity. This amounts to asking how we may *ensure the viability of biodiversity* through the direct and indirect relationships between businesses and the living world, *without compromising their economic viability.* The aim is to develop a more precise tool for assessing the direct and indirect linkages between businesses and biodiversity, thus enabling businesses to come up with concrete actions for **reintegrating their operations into biological diversity.** The composite indicator presented in the following section has been constructed in response to the above requests, focusing on *businesses' own understanding of their interactions with the diversity of living systems.*

1.3 THE BUSINESS AND BIODIVERSITY INTERDEPENDENCE INDICATOR (BBII)

1.3.1 A multi-criteria analytical tool

The *Business and Biodiversity Interdependence Indicator* (BBII) was developed in 2006 by the *Orée*-IFB Working Group with the help of the Masters Degree programme in Environmental Sciences and Engineering at the University of Paris-Diderot. The method developed was designed to be simple, to make it straightforward for businesses to perform their own self-assessments. The indicator can be applied to semi-finished or finished goods[(33)] or to the company's operations, which may be multiple and diversified, as in the case of a group or a multinational. Before the analysis is conducted, the specific features of the companies, products or operations to be analysed must be identified.

The analysis chart includes about twenty criteria. For each criterion the analysis offers four options. The business has to select one of these options by checking a box, and must also explain the response (see appendix 1):

- Not concerned by this criterion: 1
- Slightly concerned by this criterion: 2
- Moderately concerned by this criterion: 3
- Strongly concerned by this criterion: 4.

Asking for an explanation to be included along with the choice of each of the criteria is meant to give a qualitative sense of each company's understanding of its interdependence with biodiversity. After a literature review and interviews with a number of experts and businesses (Alloin, *et al.*, 2006), 23 criteria were adopted for the development of a composite indicator which **characterises the interactions between biodiversity and businesses.** These criteria are presented in table 3 below, and discussed in the following pages.

(33) Finished goods are items ready to be sold at retail. They include the item and its packaging.

1.3.1

Table 3:
Criteria adopted for the Business and Biodiversity Interdependence Indicator (BBII)

CATEGORIES	DESIGNED TO ASSESS:	
Criteria directly related to living systems	*dependence on raw materials* *dependence on services and technologies derived from living systems* *management of the variability, health and complexity of ecosystems*	C1.1 C1.2 C1.3 C1.4 C1.5 C1.6
Criteria related to current markets	*dependence of company profits on biodiversity*	C2.1 C2.2 C2.3
Criteria related to impacts on biodiversity	*impacts of company operations on living systems*	C3.1 C3.2 C3.3 C3.4 C3.5
Criteria related to compensatory measures	*offset measures*	C4.1 C4.2 C4.3
Criteria related to business strategies	*the company's strategic positioning*	C5.1 C5.2 C5.3 C5.4 C5.5 C5.6

CRITERIA

C1.1.a percentage of raw materials derived from living systems
C1.1.b percentage of raw materials derived from living systems of past eras
utilisation of ecological services (including biotechnologies)
bio / eco-mimetism
ecosystem variability
ecosystem health
ecosystem complexity

cost of raw materials derived from biodiversity as a fraction of the total production cost
market positioning (quality level linked to marketing biodiversity)
volume of sales of goods and services derived from biodiversity as a fraction of the total volume of sales

reversibility of impacts
alteration of the landscape
pollution, emissions, waste generation
selective pressures and species' viability
ecosystem fragmentation

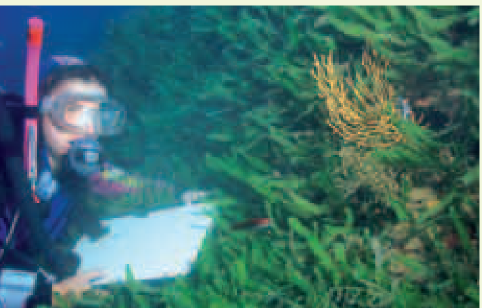
legally required compensation measures related to the impacts of the activity
voluntary compensation measures related to the impacts of the activity
monetary compensation not directly related to the impacts of the activity

importance of biodiversity for the viability of the company (going concern)
social pressures
increased competitiveness
effects of public relations efforts
creation of new markets
corporate culture

1.3.2 The selected criteria

Criteria directly related to living systems

C1.1.a Percentage of raw materials derived from living systems	This is the proportion of raw materials in a finished product or activity derived from biodiversity, including foods, timber, textiles, medicines - that is, derived from any living organisms, or their components, products or
C1.1.b Percentage of raw materials derived from living systems of past eras	This is the proportion of raw materials in a finished product or activity derived from the biodiversity of past eras, including petroleum, gypsum and any materials resulting from the decomposition (or the activity) of
C1.2 Utilisation of ecological services	Ecological services are the benefits that human populations derive, often unawares, from the workings of ecosystems. These include the natural production of resources for domesticated or hunted animals, crop pollination by insects, biotechnologies, preservation of water quality and soil fertility by plants and animals, the sequestration of carbon in wood and soil and the recycling of nutrients by many species (bacteria and earthworms). There are four categories of services:
C1.3 Bio / eco-mimetism	The goal of bio-mimetism is *to imitate or emulate "nature", copying its models and the functioning of its ecosystems* in order to develop new molecules, technologies or modes of organisation for solving human problems. Biodiversity is an inexhaustible source of innovations. Some examples: • Vaccines which do not require refrigeration, the result of research into an African plant;
C1.4 Managing ecosystem variability	Ecosystems contain many uncontrollable variables, such as temperature and season. To a greater or lesser degree these variations can disrupt the operations of a business which derives its goods or services from living
C1.5 Managing ecosystem health	"Healthy" ecosystems can be very beneficial to a business. Modifying ecosystems can affect the availability and quality of raw materials and services derived from living systems. Ensuring the good ecological status of ecosystems in which a company operates can also lead to additional
C1.6 Managing ecosystem complexity	Understanding the complexity of ecosystems is advantageous for businesses. Although it is possible to circumvent its complexity by simplifying the ecosystem's dynamics and replacing them with exogenous production factors, this often has significant ecological impacts. An example of the *circumvention of complexity* is greenhouse crop production in order to control the vagaries of climate and optimise growth, as in the case of the hydroponic cultivation of tomatoes in Andalusia, which replaces natural habitats often rich in biodiversity and inexorably degrades groundwater quality through increasing pollution by pesticides



models usable as biotechnologies. The assessment can be performed by calculating the ratio of the mass of the raw materials derived from living systems to the total weight of the finished product. The entire chain of production and supporting activities is involved.

living organisms over geological time. The assessment is performed in the same way as for the previous criterion and has the same scope.

- **Supporting services:** primary production, provision of habitats, nutrient recycling, retention and creation of soil, production of oxygen in the atmosphere, the water cycle; support services underpin the other services which human populations derive from ecosystems.
- **Provisioning services:** water, hunting, fishing, gathering and biotechnologies.
- **Regulating services:** resistance to species invasion, use of biomass, pollination, seed dispersal, climate regulation, protection against parasites, regulation of human diseases, protection against storms, protection against erosion, water purification, control of animal populations(34).
- **Cultural services:** spiritual, recreational, cultural and educational benefits.

- Anti-friction surfaces usable in modern electrical systems, inspired by the remarkably slippery skin of the sand skink, a lizard native to the Arabian Peninsula;
- New antibacterial substances derived from marine algae found on the coast of Australia, a discovery which opens up possibilities for combating certain infectious bacteria without strengthening their capacity for resistance;
- An advanced system for recovering water by recycling steam from cooling towers, so that buildings can get all the water needed from dampness in the air. It is inspired from the Namib Desert beetle's technique for getting its water supply from coastal fogs.

systems, including biological ingredient gathering, seasonal hunting and fishing, extraction of oil in the Arctic during the summer, or a grape harvesting season starting three weeks earlier due to global warming. These variations can have positive or negative influences for businesses.

costs. For example, a local government might require that an invasive alien species introduced on an industrial site be eradicated, either for public health reasons or to avoid its spread (and associated damages) to nearby property.

and fertilisers. This approach is generally adopted only when the advantages outweigh the disadvantages.
An example of *acknowledging complexity* is the interaction among living organisms in biotopes under "ideal" conditions, such as the symbiotic relationship between hosts and parasites which is fundamental to many active ingredients used for cosmetic purposes. Artificially reproducing these interactions under ideal conditions in order to obtain the active ingredients desired can be extremely costly, thus encouraging the correct management of the ecosystems where they can be harvested. For example, the oak-gall or oak-apple is a spherical growth on the leaves of an oak species *(Quercus pubescens)* resulting from eggs laid on the tree by a species of hymenoptera, the gall wasp. Tannins are derived from the oak-galls in late summer, before the insects emerge. These tannins were traditionally used to produce a black dye for silk and black ink for manuscripts.

(34) Myxomatosis regulates rabbit populations.

1.3.2

Criteria related to current markets

C2.1 Cost of raw materials derived from biodiversity as a fraction of the total production cost	The assessment is performed by calculating the ratio of the cost of the raw materials derived from living systems to the total manufacturing cost of the finished product.
C2.2 Market positioning (quality level linked to marketing biodiversity)	This criterion refers to the difference between the manufacturing cost and the sale price of an item. This will be more or less significant depending on the level at which the item is positioned within the possible range for this kind of product. For example, the total cost to manufacture a pair of shoes may be 15 €, while their sale price may vary from 50 to 200 €. The goal is to analyse the importance of biodiversity with respect to positioning.
C2.3 Volume of sales of goods and services derived from biodiversity as a fraction of the total sales volume	This criterion is designed to express the proportion of a business's sales that are directly or indirectly dependent on biodiversity. The assessment is performed by calculating the ratio of sales of products and services related to biodiversity to the business's total sales volume.

Criteria related to impacts on biodiversity

C3.1 Reversibility of the impacts	Some of a business's assets and activities can have a lasting impact on the ecosystem, others not. One way to assess the reversibility of the impacts is to calculate the time required to restore the ecosystem of a site occupied by a business to its initial ecological status, assuming no further human intervention.
C3.2 Alteration of the landscape	This criterion addresses the direct destruction, the indirect degradation or the alteration of the landscape. One should also consider the psychological meaning, positive or negative, attached to the impairment of ecosystems. Vineyards can be viewed as "natural", as an intrinsic part of the landscape, while nobody wants to live next to a quarry site. However, vineyards are just as much an alteration of the landscape as quarries.
C3.3 Pollution, emissions, waste generation	Modern industrial processes generate large quantities of waste products, effluents and emissions which affect the ecosystem dynamics, with sometimes irreversible effects on their functioning and biological components. For instance, nitrate pollution results in the spread of algae or other plants which suffocate other life in bodies of water.
C3.4 Selective pressures and species' viability	The introduction of alien species, such as the bullfrog and Florida turtle in France, may exert pressure on existing ecosystems and even oust some indigenous species. Species overharvesting may lead some of them to disappear either locally or entirely, as can happen in the case of fish stocks, such as the Mediterranean blue-fin tuna. Moreover, many industries actively promote the development of useful species instead of and in place of diversified ecosystems: rubber plantations for the manufacture of latex, plantations of alien species of pine tree grown as even-aged monocultures, or soybean crops for the production of agro-fuels.
C3.5 Ecosystem fragmentation	This criterion addresses the contribution of the business's operations to the fragmentation of natural habitats by interrupting ecological continuity. For example, building a motorway can cut an ecosystem in half and impede the movements of some of its organisms.

1.3.2

CRITERIA RELATED TO COMPENSATORY MEASURES

The objective is to assess biodiversity offsets, including the business's efforts to minimise its direct and indirect impacts on ecosystems. This can take concrete form in the restauration or biological diversification of the ecosystems in which the firm operates. More precise indicators could be adopted depending on the specific areas, species, habitats or biophysical functions to be restored.

C4.1 Legally required compensation measures related to the impacts of the activity	This criterion refers to the minimum required by regulations. In some countries, companies engaged in mining are legally obliged to restore the habitats they have altered or destroyed to its "original state".
C4.2 Voluntary compensation measuresrelated to the impacts of the activity	This concerns the assessment of the cost of compensatory measures not required by regulation. Some companies hire landscapers and ecological engineers to restore habitats on the land they have used.
C4.3 Monetary compensation not directly related to the impacts of the activity	Donations or actions made by the company for biodiversity conservation, even though the business activity has no direct negative impact on biodiversity.

Criteria related to business strategies

C5.1 Importance of biodiversity for the viability of the company (going concern)	Is biodiversity one of the keys to the sustainability of business activity? A company whose chief raw material comes from living systems has an interest in preserving that renewable resource in order to ensure the sustainable growth of its income. For example, the research and development division of a cosmetics company will have an interest in preserving the ecosystems in which it finds the active ingredients for the production of perfumes or skin lotions.
C5.2 Social pressure	This refers to the force of public opinion with respect to biodiversity vis-à-vis a business's operations. The construction of a waste treatment facility often meets with opposition from community groups such as associations of local residents, while building a supermarket poses fewer problems.
C5.3 Increased competitiveness	Taking account of biodiversity can produce a competitive advantage. For example, "organic" products see their market share increase year on year. At the same time, the degradation of an ecosystem can generate additional costs and reduce competitiveness.
C5.4 Effects of public relations efforts	Biodiversity can be a key element of the company's marketing of itself to outside audiences, for instance in its annual CSR report. It can also be a source of opportunities, including access to new markets and to investors concerned with the company's environmental performance.
C5.5 Creation of new markets	Biodiversity is a source of innovation, of new products and services. What challenges and opportunities does this offer a business?
C5.6 Corporate culture	Biodiversity can be used to drive in-house communication and training in order to enrich the corporate culture.

1.3.3 The interactions between businesses and biodiversity

The main goal of the *Business and Biodiversity Interdependence Indicator* (BBII) is to highlight the **direct and indirect interactions between businesses and the living world** (Houdet and Weber, 2007; Houdet, 2008). A pentagram of the results of each self-assessment can be developed. This provides a **global picture of a business's own understanding of its interdependence with biodiversity.** The views of the interviewee are specified within the assessment chart by associating each rating with an explanation. It must be emphasised that the assessment results rely entirely on the interviewees' knowledge, most obviously that of the direct[35] and indirect[36] dependence and impacts of the business on biodiversity. This will inevitably be influenced by their position within the company, their values and the intra-organisational policies and conventions they follow[37]. This automatically limits the value of the responses, but once identified these biases can be eliminated in subsequent research.

While the BBII does not claim to function as a method for auditing a company's activities with respect to biodiversity issues, it responds to a *genuine demand on the part of businesses with respect to their positioning.* There is a widely expressed need for a recognised tool to function as a standard on this issue. The BBII can be used in order to compare the views of different companies within the same industry as well as to analyse the similarities and dissimilarities among different industries or among employees within one company. We can expect it to function as a form of *consciousness-raising* and *stimulus to action* for all the divisions within a company. At that point, the BBII could become a genuine tool for annual self-assessments.

Modified to reflect the specificities of each industry, to the extent deemed necessary by its users, the BBII can enable companies to:

- **Identify and assess their interactions with biodiversity,**
- **Identify a starting-point and position themselves with respect to it,**
- **Make explicit and promote situations of mutualistic interdependence** between their operations and biodiversity,
- Begin **to develop sets of performance indicators,** appropriate to their specific situation or activity, for taking biodiversity into account within their management systems,
- Propose and implement **concrete actions** for the viability of biodiversity.

(35) That is, the dependences and impacts connected with the business's normal activity, which it can control and for which it takes full responsibility.
(36) This covers the dependences and impacts of the firm's suppliers as well as interactions between products and biodiversity, from the moment of their conception to their end-of-life.
(37) An accountant will respond differently from an engineer or someone from the marketing division, even though they belong to the same organisation.

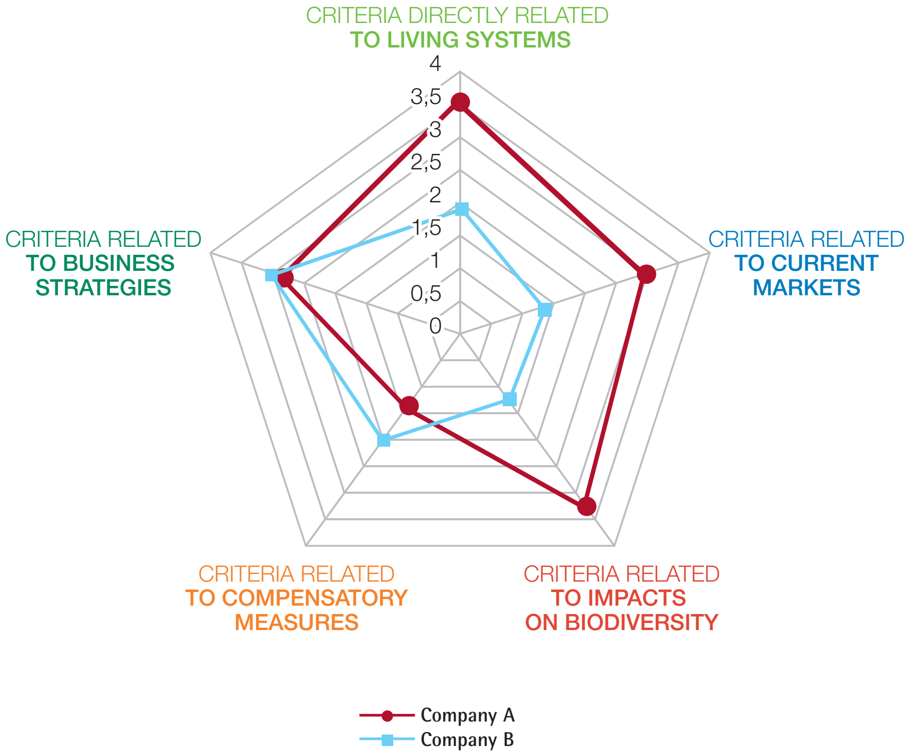
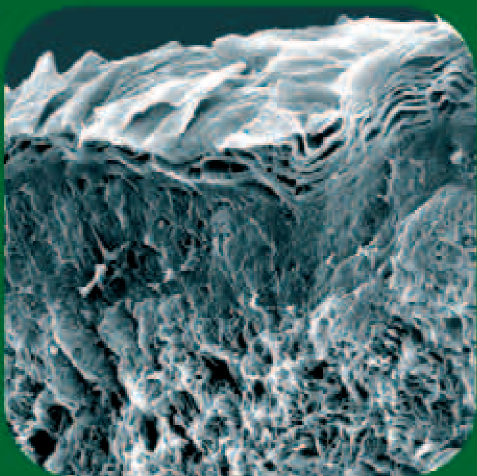


Figure 7 :
A comparison of pentagrams of results for the BBII from two hypothetical businesses. Each axis represents the average of the criteria within the group of corresponding criteria.

SECTION 2
THE INTERDEPENDENCE OF BUSINESSES AND LOCAL GOVERNMENTS WITH BIODIVERSITY



2.1
TESTING THE BUSINESS AND BIODIVERSITY INTERDEPENDENCE INDICATOR

2.1.

Since June 2007, numerous interviews bearing on the *Business and Biodiversity Interdependence Indicator* (BBII) have been conducted with various organisations:

- Private companies;
- Business associations;
- Local governments.

Applying the BBII to individual businesses and business associations did not pose any methodological problems, but it was found necessary to adapt some of the criteria for local governments. In the case of a municipality, or a regional authority, sales figures and market positioning are not relevant: one would discuss, respectively, their budget and the attractiveness of the town or region in question. The composite indicator adapted for local governments is presented in the appendices (p. 362) as the *Local Governments and Biodiversity Interdependence Indicator* (LBII).

The **self-assessments** below, shown in alphabetical order, present the **perception which each business, business associations and local government has of its own interdependence with biodiversity.** Our thanks go out to the organisations which have agreed to undertake and publish these self-assessments, which are intended to encourage other businesses and local governments to reflect on their interactions with biodiversity. Each self-assessment is composed of three complementary parts:

a. Description of the organisation, with a pentagram showing its interdependence with biodiversity, as established by the self-assessment;

b. Summary of the interview with *Orée*, organised in terms of the five components (or groups of criteria) of the BBII: *"criteria directly related to living systems", "criteria related to current markets", "criteria related to impacts on biodiversity", "criteria related to compensatory measures", "criteria related to business strategies";*

c. The steps being taken to promote biodiversity, with emphasis on best practices which can encourage other organisations to follow suit.

Beyond the biases associated with the learning curve and the subjectivity of each organisation's corporate culture, using the BBII could well become a **unifying exercise conducted on an annual basis.** As the results of the self-assessments by employees evolve over time, the process could actively contribute to group learning.

2.1.1 BUSINESSES AND BUSINESS ASSOCIATIONS

2.1.2 LOCAL GOVERNMENTS

* Member of *Orée.*

2.1.1

Over the last 30 years, Alban Muller International (AMI) has built up an expertise in the field of natural cosmetics, herbal health care and health foods that is recognised worldwide. Based on advanced research in the biological sciences, the group has established a strategy firmly focused on sustainable development.

Building on "smart environmentalism" and the "Made in France" guarantee of quality, AMI is today a pioneer in eco-design. Its global approach, the only one of its kind, is inherent in all stages of production, from seed selection to formulation, from raw materials to turnkey products.

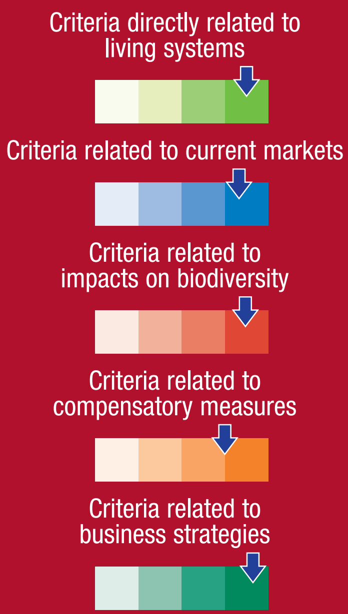
AMI's strategy relies on two principles:

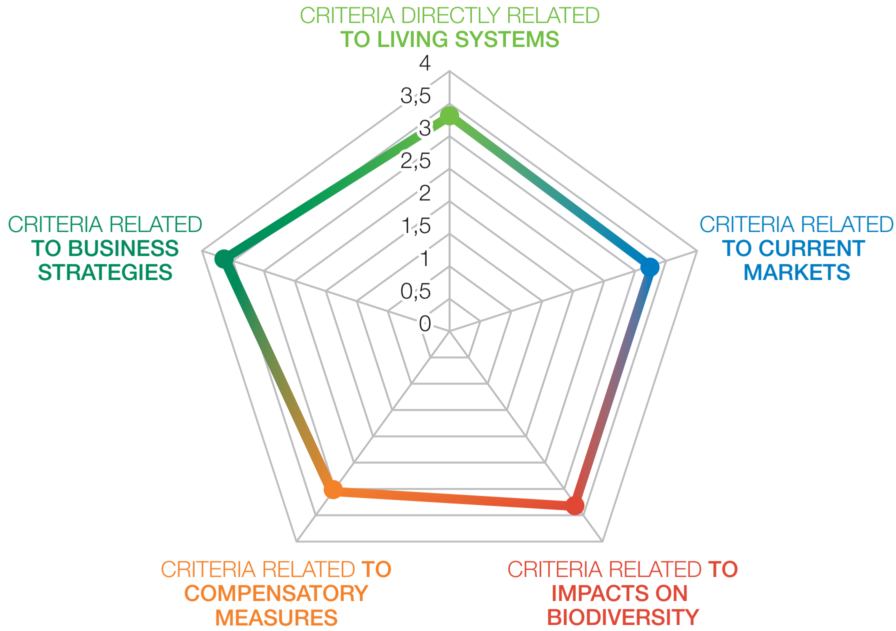
- responsible design of its products;
- promotion of biodiversity.

ALBAN MULLER INTERNATIONAL IN FIGURES

- 2007 sales of **23.1M €**of which **72%** is in exports dont **72 %** d'exportations
- **130** staff members in more than **50** countries
- **10 %** of turnover allocated to research
- **150** cosmetics formulated using **400** metric tons of herbal essences

SELF-ASSESSMENT





> *Alban Muller International makes a genuine effort to manage its impacts on ecosystems throughout the production chain, from seeds to finished product.*

THE INTERDEPENDENCE OF ALBAN MULLER INTERNATIONAL WITH BIODIVERSITY

SUMMARY OF THE INTERVIEW WITH *ORÉE* ABOUT THE BUSINESS AND BIODIVERSITY INTERDEPENDENCE INDICATOR

CRITERIA DIRECTLY RELATED TO LIVING SYSTEMS

Dependence on raw materials derived from living systems

The plant extracts used for cosmetics, health foods and herbal health care account for the bulk of the **raw materials derived from the natural world** for AMI's use. The **fossil resources** required for transport and packaging are also substantial. Significant amounts of solvents from the distillation of wheat or beets or the transesterification of sunflower oil, palm oil and rapeseed oil are used in preference to petroleum distillates.

2.1.1

Dependence on services and technologies from living systems

Cultivation of medicinal plants and water consumption are the main areas in which the group depends on **ecosystem provisioning services.** Copying the natural world's properties and models for its product designs is part of the corporate culture. AMI researches active ingredients to uncover their potential human applications. Adopting the properties of rot-resistant wood for some antiseptics is a good example of **biomimetism,** as is the use of the active ingredients which protect high-altitude plants from ultra-violet rays for skin protection products. Plants are typically processed using techniques of maceration, percolation, and vacuum concentration.

Harvesting angelica with a combine harvester

Management of the variability, health and complexity of ecosystems

The production of herbal extracts is affected by unpredictable bio-climatic conditions. This **variability** presents both threats and opportunities. While extreme conditions (frost, drought) are to be feared, climate change may be favourable to the growth of a desirable species. Climate, seasons and **ecosystem health** influence the concentration of active ingredients in plants, which in turn affects the price of these raw materials. At the same time, threats from parasites like Dutch elm disease mean additional costs. Taking the complexity of the ecological dynamics of ecosystems into account is thus crucial to innovation. **Profits are regularly derived from this complexity,** which is often impossible to reproduce ex situ. Oak trees are infected by an insect which leads to the production of a valuable chemical. To identify the variables regulating the concentration of usable chemicals, AMI focuses its research on interactions between organisms like these.

CRITERIA RELATED TO CURRENT MARKETS

In dry weight equivalent, the plant biomass processed annually by the company amounts to almost 400 metric tons. In terms of **trading volume,** products from the natural world account for almost all (95%) of sales. Although this varies depending on the active ingredients in question, the **cost of resources derived from biodiversity** is significant for the company. Committed to the quality of its products, AMI offers "upmarket" items, and its **market positioning** is firmly bound up with the natural world. Building on "smart environmentalism" and responsible design of its products, AMI is a "Natural Product Designer®".

A field of jojoba plants

CRITERIA RELATED TO IMPACTS ON BIODIVERSITY

The question of impacts on biodiversity primarily concerns suppliers who cultivate or gather the desired extracts. Above all, the **impact of extraction** from the natural environment must be minimized, taking care not to threaten the survival of any species. A real challenge today is that of limiting the spread of dry residue from monocultures, which are responsible for the destruction of environments rich in biodiversity. In the case of the plants managed by the company, **integration into the landscape** and the **control of pollution** are a priority. At our Chartres site, "filtration gardens" with a positive effect on local biodiversity have been developed to treat effluent, and farmers are paid to collect and use composted plant waste on their crops. To reduce its greenhouse gas emissions, the company is also investing continually in technologies and processes which are less energy-intensive, such as drying by zeodratation, a low-temperature dehydration process.

CRITERIA RELATED TO COMPENSATORY MEASURES

AMI is not affected by **legally required compensation.** However, the harvesting of rare and protected species is systematically complemented by restocking or replanting. This applies to Polynesian sandalwood and Brazilian rosewood, where felling the trees is balanced by **voluntary compensation** on the lines of "each tree cut down means three new ones planted". **Corporate sponsorship** is another way of offering compensation to biodiversity, as exemplified in the Herboretum, an organisation we oversee, founded in 2004 and dedicated to protecting local biodiversity and to raising awareness of nature and its wise use.

CRITERIA RELATED TO BUSINESS STRATEGIES

Biodiversity issues have an important place in **company policy.** Customers today are more concerned with the eco-design of products and the environmental impact of industrial techniques. Taking account of and managing environmental impacts **throughout the production chain** are two fundamental elements of the **company's image** and its development: despite the initial additional costs, they belong within a consistent long-term strategy. **Communication** about efforts in this direction, both internally and vis-à-vis the general public, is vital for expanding the adoption of best practices and, ultimately, approaching and persuading **new customers.** For all these reasons, a multidisciplinary team of chemists, pharmacists, biologists and cosmetologists, all of them plant specialists, strives to implement cleaner technologies and environmentally smart products.

2.1.1

The steps taken by Alban Muller International to promote biodiversity

SUSTAINABLE MANAGEMENT OF BIODIVERSITY

Alban Muller International is committed to managing the impacts of its production methods. This takes concrete form in the following actions:

- Using cultivated plants for preference, and for those collected in the wild the application of extremely strict rules to ensure that collecting does not endanger the plant in its natural environment. For AMI, only through managed cultivation can we engage in plant conservation and improve crop varieties without genetic manipulation;
- Using natural solvents like water, ethanol and plant-based glycerine for all new products;
- Implementing energy-efficient techniques such as zeodratation and flash-pasteurization;
- Strictly controlled management of waste, in particular through the use of holding tanks to prevent contamination;
- Reducing water consumption and treatment of effluent in "filtration gardens" for recycling water used in manufacturing processes.

As a result of its continual improvement in environmental performance, AMI's manufacturing site in the Cosmetic Valley has been certified ISO 14 001 since 2004.

FROM SEEDS TO FINISHED PRODUCT: MANAGING THE PRODUCTION CHAIN

Alban Muller International has developed a comprehensive and unique approach involving intervention at every stage of the production chain. One of its slogans, "from seeds to finished product", bears witness to its desire to manage the impact of each of its operations, from seed selection and plant cultivation to the formulation of its products.

Drawing on the expertise of French farmers, the group prefers to deal locally: today more than 60% of the tonnage of its plants, from about 100 species, are grown in France. Medicinal plants are harvested in the heart of the Beauce, a region known for high-quality agricultural production, where fields of angelica, echinacea, St. John's wort and coriander now share the land with wheat fields. More than 75 species of medicinal plants are grown on 600 hectares, thereby promoting the diversification of agro-systems.

In close collaboration with the farmers so as to ensure the quality, traceability and diversity of the supply of plants, special cultivation techniques have been developed: selection of seed varieties with maximum active content, species adaptation, quality control of crops at all stages of their development, intelligent use of fertilizers and pesticides, control of harvesting and drying conditions to optimize the proportion of active ingredients in the plants.

FILTRATION GARDENS, A FIRST IN THE COSMETICS INDUSTRY

To improve wastewater treatment at its site in Fontenay-sur-Eure, the group has opted for phytoremediation, an ecological and aesthetic alternative to traditional reprocessing in a treatment station. Jardins Filtrants®, an original technology developed by the company Phytorestore was adopted: plants do most of the work of effluent processing. These gardens, a world first in the cosmetics industry, create diversified wetlands with their own fauna and flora.

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2.1.1

Autoroutes du Sud de la France

Une société de VINCI CONCESSIONS

Autoroutes du Sud de la France (ASF) forms part of VINCI, the major integrated company in the concessions and construction field worldwide. Its subsidiary companies include Autoroutes Estérel, Côte d'Azur, Provence, Alpes (ESCOTA) and Openly (Périphérique Nord, Lyon).

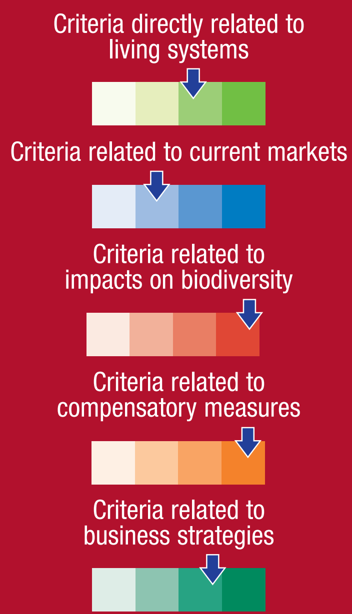
ASF, founded in 1957, operates an extensive motorway system, occupying a strategic position in France south of the line joining Angers to Lyon and Aix-en-Provence. It thus links Northern Europe, the Mediterranean and the southern part of the Atlantic coast.

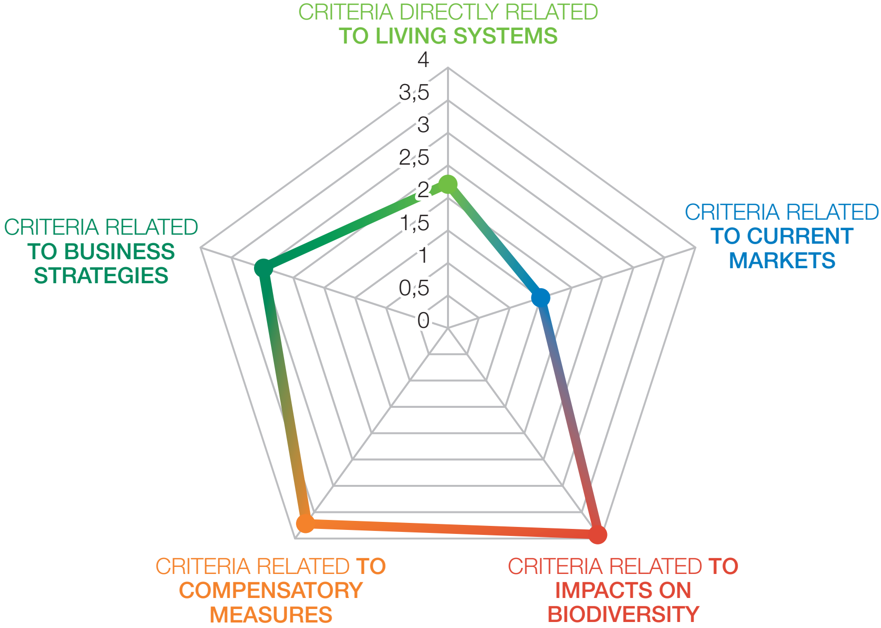
ASF's expertise lies in its ability to operate motorways of many different kinds. The company's mission is to facilitate the movement of goods and people in complete safety and to implement a secure, sustainable infrastructure which respects both the environment and the nearby inhabitants. ASF is aware of the issues involved in constructing motorways in a natural landscape, and is perpetually committed to harmonising land use, safety, traffic flow and the protection of the ecological wealth of the environments they intersect. The company has built up skilled experience in the restoration of environments and reversing the fragmentation of wildlife habitat areas.

AUTOROUTES DU SUD DE LA FRANCE IN FIGURES

- 2007 sales of **2234M €**
- **2590 km** of existing motorways and **123 km** planned
- **226** junctions and **299** service and rest areas
- **5 437** employees of whom **43%** are women
- **1 504** water protection facilities and **9840 ha** of green space.

SELF-ASSESSMENT





> *Bringing the motorway network into harmony with its environment by preserving ecological continuity is an ongoing challenge for Autoroutes du Sud de la France.*

THE INTERDEPENDENCE OF AUTOROUTES DU SUD WITH BIODIVERSITY

SUMMARY OF THE INTERVIEW WITH *ORÉE* ABOUT THE BUSINESS AND BIODIVERSITY INTERDEPENDENCE INDICATOR

CRITERIA DIRECTLY RELATED **TO LIVING SYSTEMS**

Dependence on raw materials derived from living systems

The company uses very few **raw materials from living systems,** with the exception of the purchase of plants for motorway planting, and food, furniture and office supplies for administrative use. In contrast, it relies significantly on **raw materials from living systems of past eras.** This includes the fuel consumed by the motorway system's maintenance vehicles, tar for the roadway surfaces and limestone aggregates for embankments. Every day, thousands of vehicles consume fuel as they travel on the motorway system.

2.1.1

Dependence on services and technologies from living systems

Motorway systems require relatively wide surface areas - 7 ha / km for a 70-metre wide carriageway. This may impact negatively on ecosystems and their ecological functions. **Environmental engineering** is applied to the solving of these problems through the restoration of watercourses, planting on embankments and filtration of storm runoff. Green buffer zones along the sides of the motorways provide one level of **ecological services,** such as carbon sequestration through the growth of the plants. They can also play an important landscaping role, constitute reserves of biodiversity and enable the movement of some species in hostile surrounding areas (monocultures).

Dependence on services and technologies from living systems

Road safety is affected by many **environmental hazards** including floods, high winds which bring down trees and accidents caused by animals wandering on the roads. Managing these risks is one of ASF's major concerns, and has prompted investigation of the implications of climate change for motorway management. With respect to **ecosystem health,** the company must make sure that the environments for which it is directly responsible are in good condition ecologically, by preventing watercourse pollution and controlling alien species which could pose public health problems. Unlike most economic activity, which seeks to break from the **complexity of living systems,** managing motorway edge areas involves promoting natural dynamics even if this imposes constraints. Accommodating the reproduction and migration cycles of certain species can lead to construction delays. ASF has to manage the complexity of the interactions between green spaces, surrounding areas and local inhabitants while facing the sometimes contradictory concerns and expectations of stakeholders.

Green embankments along the motorway: a benefit for the traveller

CRITERIA RELATED TO CURRENT MARKETS

ASF is in charge of the entire motorway system. **Expenditures associated with living systems** consist mainly of purchases of seeds and plants for landscaping, a relatively small amount compared to other operating expenses (personnel) and investment. Today biodiversity is central to the integration of motorway construction with the landscape, and plays a key role **in community acceptance and attractiveness of the road system.** It gives travellers pleasant surroundings on the road and at the rest areas, and also satisfies the expectations of local inhabitants, including conservation organisations who are especially concerned with the maintenance of ecological continuity.

CRITERIA RELATED TO IMPACTS ON BIODIVERSITY

ASF manages a significant land area via its motorway system. The system can **fragment habitats** and **alter the landscape,** but although these impacts are real they are not inevitable. The company's expertise allows it to integrate construction as smoothly as possible into the environment and to restore ecological corridors using appropriate installations such as wildlife crossings. While these corridors meet the needs of large mammals such as deer and wild boar, they will also have to accommodate other species with a more complex life cycle. When a motorway is in use, **pollution** is usually accidental and related to the transport of hazardous materials. Chronic pollution is limited to fuel consumption and road salt as well as the pesticides and detergents used to ensure the cleanliness of the service areas. ASF needs to manage and reduce these hazards. The company is aware of the **emissions** from the vehicles which use the system, and encourages its customers to drive in a flexible and sensible way, reducing speeds during times of peak pollution and summer holiday travel periods.

Construction is integrated into the landscape

CRITERIA RELATED TO COMPENSATORY MEASURES

Regulatory requirements are fairly stringent in public works projects. Strict control techniques for managing water, air and noise pollution are required by companies licensed to operate via MEEDDAT's department of road management. With respect to biodiversity, at every stage of the project impacts must be avoided, minimized or offset, from the choice of route to its design, development and excavation. If there is no alternative to the destruction of an area of ecological significance, there must be compensation for the damage. Since 2004, ASF has been supporting the Fondation Nicolas Hulot pour la Nature et l'Homme as a "biodiversity partner". ASF participates in the "Hermann's tortoise on the Plaine des Maures" initiative, which is pushing for a national programme to restore this species.

CRITERIA RELATED TO BUSINESS STRATEGIES

Today biodiversity is a new challenge, closely associated with the growth of **community and regulatory pressures.** Some of these pressures have to do with **access to resources** (aggregates) for the construction and maintenance of road works, with respect to managing the environmental impacts of quarrying operations. Others have to do with managing the impacts motorways may have on biodiversity, for the land areas they occupy can help to provide ecological continuity on a regional or national level. ASF today has access to **engineering expertise** which should enable it, subject to available funding, to integrate biodiversity into all its projects and the land areas it utilises. **Educational efforts** are called for from all those involved in land use and management. Internally, while the issues associated with the landscape have been clearly identified, an ecosystemic perspective on motorway management needs to be developed.

2.1.1

Environmental engineering in the management of riparian buffer zones

The steps taken by Autoroutes du Sud de la France to promote biodiversity

INTEGRATION INTO THE LANDSCAPE, A MAJOR CHALLENGE FOR ASF

The choice of route to be followed is crucial for the implementation of a new road construction project. A strip of land 300 metres wide is established by the state within which the future motorway can be built. Inside this zone, the job of ASF is to choose the best possible route given the environmental (protected sites, water), human (dwellings) and technical constraints.
There are several advantages to establishing a buffer in the form of bands of vegetation at least 12 metres wide on either side of the carriageway. This produces enough plant life to mask the vehicles and absorb a portion of their noxious products (noise, dust, CO_2). A study by the Centre National de la Recherche Scientifique showed that this space is also conducive to the growth of small plants and animals. Beyond creating these buffer areas, ASF works actively with local communities to make sure that urban and industrial facilities are not sited too close to the roads.

Maintaining green embankments along the motorways

The green embankments are the strips planted with shrubs and grasses along both sides of the motorway. For each km of carriageway, there are about 4 hectares of embankment. Their design now takes into account the local characteristics of the climate, soil, phytosociology and basically the landscape as a whole. Plant species native to each region are encouraged to colonize these areas, since species transplanted from elsewhere require more maintenance.

Artificial waterway for otters on motorway A89

Protecting the natural environment: from planning the route to everyday operation

To avoid zones of ecological importance and unique biotopes when planning a motorway, a comprehensive investigation identifies the groups of plants and animals in the area, from seeds to deer by way of butterflies and orchids. In 2002, ASF implemented 13 initiatives to preserve unique environments, with 41 more from 2002 to 2004. In some instances plant species were moved and biotopes recreated elsewhere. In the Hautes Alpes, on the Sisteron to Saulce section of the A51, ASF's subsidiary ESCOTA funded a rescue operation for four rare plants and a rehabilitation project in an area of more than 5 ha of wetland in the town of La Saulce, under the supervision of the Conservatoire Botanique de Gap Charance.

Wildlife crossings

To avoid splitting up habitats and to restore wildlife freedom of movement, additional bridges and tunnels are built above and below the motorways. Suitable fencing is also installed, and the crossings are monitored on a regular basis, in consultation with hunting organisations.

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2.1.1

botanic
un nouveau mode de vie

Founded in the Savoie by families of gardeners, Botanic's origins bind it tightly to the land and to nature. The company markets a wide range of products, from gardening to animal breeding to organic foodstuffs. The image Botanic has nurtured is that of a retailer associated with natural products and services.

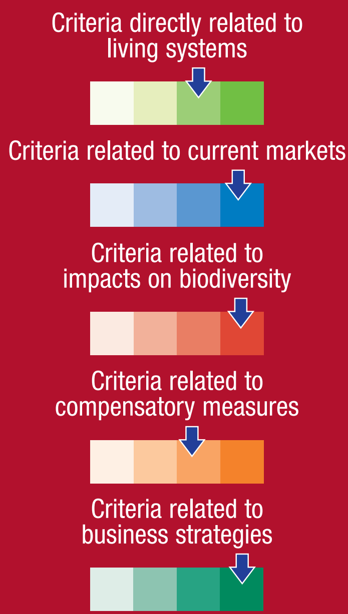
Ever since 2005, sustainable development has been a topic of careful consideration and is now central to its business strategy. For the company this represents a long-term, deliberate and responsible approach to improving and sustaining quality of life through intelligent, respectful and shared use of resources.

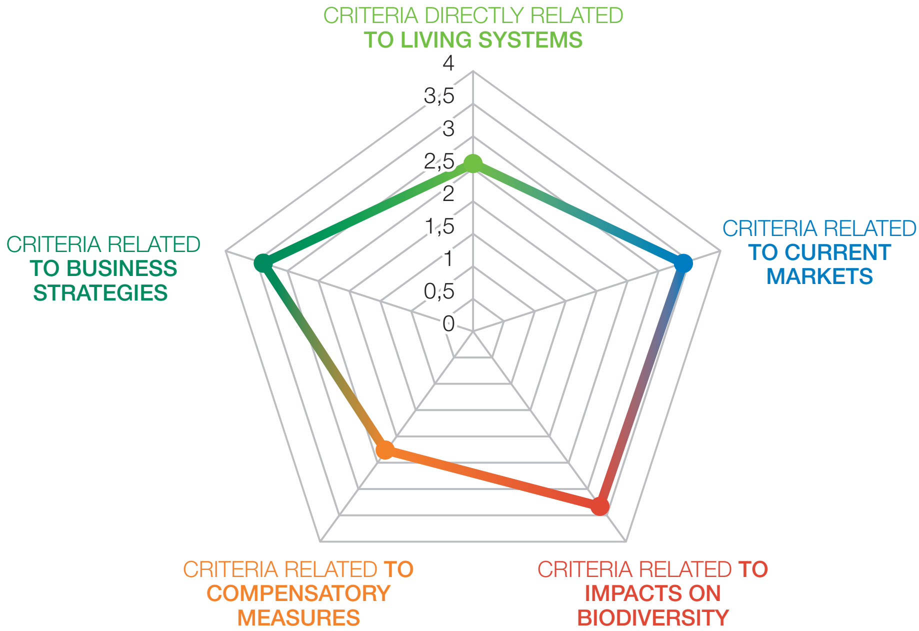
It was this in mind that the Botanic "pact" was developed, consisting of 25 concrete commitments to be implemented between now and 2010. Recently, all Botanic shops have become "pesticide zero-tolerant", that is, free of artificial fertilizers and chemicals. They offer environmentally sound alternatives for home and garden.

BOTANIC IN FIGURES

- 2007 sales of **290M** €
- **57** retail outlets in France, **6** in Italy
- **2100** salaried staff
- **25** commitments to act in support of sustainable development

SELF-ASSESSMENT





“Customers are willing to change their behaviour as soon as they know they have concrete alternatives. Botanic wants to play an active role in this transformation of the modes of consumption and production.”

THE INTERDEPENDENCE OF BOTANIC WITH BIODIVERSITY

SUMMARY OF THE INTERVIEW WITH *ORÉE* ABOUT THE BUSINESS AND BIODIVERSITY INTERDEPENDENCE INDICATOR

CRITERIA DIRECTLY RELATED TO LIVING SYSTEMS

Dependence on raw materials derived from living systems
The products manufactured by Botanic, including wooden garden furniture, horticultural products, foodstuffs and pets, originate for the most part from **natural raw materials.** Delivery of its products to over 60 stores in France and Italy requires a high **consumption of fuel,** a natural resource bequeathed to us by previous eras.

2.1.1

Dependence on services and technologies from living systems

Although the notion of **ecosystem services** is difficult to conceptualize clearly, the company is concerned for its responsibility vis-à-vis ecosystems. It derives foodstuffs and water from them as well as the biomass for its textile products. At the same time, it depends indirectly on ecological supporting and regulating services via the ecosystems drawn upon by its suppliers. Botanic's own goal is to promote biodiversity in the garden by creating a diversified ecosystem: the company recommends environmentally sound gardening to its customers, through simple methods which are easy to put into practice. Activities are carried out in harmony with nature, replacing chemical additives with techniques based on revitalization and cooperation between various components of the ecosystem. An obvious example of this **ecomimetism** is the composting of organic waste. Using this compost as a soil amendment ensures the completion of a natural cycle.

Management of the variability, health and complexity of ecosystems

Whether customer or employee, everyone is affected by the constraints and opportunities presented by ecosystems. While unpredictable weather is often responsible for additional costs at the supply level, **climate variation** also determines the diversity of species, giving rise to new products. The **health of ecosystems** is of crucial importance for the quality, quantity and availability of products. It also lies behind a powerful message that the Botanic shops send to their customers to encourage ecological gardening. Particular attention is devoted to the monitoring of invasive species, by informing suppliers and customers and making them aware of the issue. Taking into account the **complexity of ecosystems** means selling products that encourage ideal conditions for maintaining biodiversity in the garden. This comes up especially with respect to combating garden pests by using non-exotic controller species and suitable native plants.

CRITERIA RELATED TO CURRENT MARKETS

While the **cost of materials** from the natural world is significant, it does not outweigh the costs of the workforce. With 60% to 70% of the items marketed derived from biodiversity, the company's development focuses on supplying diversified products for a way of life that is close to nature. Its **market positioning** is tightly linked to respect for the natural world, which is what differentiates Botanic from other retail outlets.

CRITERIA RELATED TO IMPACTS ON BIODIVERSITY

To claim **reversibility** in the case of property assets would be fanciful. Like any operation in an urban area, each shop forms part of a commercial space. Built of glass and wood rather than the ubiquitous concrete, the buildings are designed **to fit more smoothly into the landscape.** Botanic also emphasises the traceability of its products, taking this beyond the usual labels of origin to show a genuine commitment to responsible supply sources. The group has minimal influence when it comes to changing markets, space management methods or the production of raw materials. On the other hand, ecological gardening has a positive impact at the individual level. In a long-term plan for reducing its **direct impacts,** Botanic has removed artificial fertilizers and pesticides from its product line. The use of eco-packaging and optimization of transport systems are other avenues for improving our practice. Returning products at the end of their useful life back into the natural cycle calls for innovation: for example, roses are now packaged in biodegradable coir containers which can be directly planted in the ground. The company prefers to source its pets from local breeders. In the case of **imported wild species,** eco-sensitive sources are sought out, such as fish certified by the Marine Aquarium Council.

CRITERIA RELATED TO COMPENSATORY MEASURES

Although Botanic is not affected by **legally required compensation,** the commitment to the Botanic "pact" is a form of **restitution to biodiversity.** The company allocates more resources to managing its own impacts on ecosystems than to sponsorships. A noteworthy exception to this is its **funding** of the Bastide du Parfumeur in Grasse, a veritable botanical conservatory containing more than 200 flower varieties.

CRITERIA RELATED TO BUSINESS STRATEGIES

What company today can afford the luxury of turning its back on environmental challenges, especially the erosion of biodiversity? For Botanic, this awareness is crucial. It is inherent in our thinking at all levels, from the supply of raw materials to after-sales service. The 25 commitments of the Botanic "pact" identify concrete goals with respect to each type of product. Botanic enjoys positive relations with its **customers** and **conservation organisations,** with whom it has built several partnerships. Working for sustainable development is not always easy, however. It can generate additional costs in the short term, for example the temporary downturn in sales resulting from the removal of artificial fertilizers and pesticides, as well as the costs of research into substitutes for these products. The regulatory framework can be hostile to the development of certain products, for example in the case of liquid nettle manure which stimulates a plant's natural defences but whose use in the garden is prohibited in France. Botanic increases its **competitiveness** in the market by offering original products designed for environmentally aware consumers.

The shops attract nature lovers

2.1.1

The recent craze for organically farmed foods suggests the **new potential markets** relating to biodiversity. For example, offering more varieties of apples than the five marketed worldwide increases the diversity on supermarket shelves and also agro-biodiversity on the farm. In 2007 this approach won Botanic the environmental innovation prize from the "Bref Rhone-Alpes" Trophées de l'Innovation. At present, **in-house communication** and **training** are actively oriented to sustainable development. Team spirit is definitely at work, propelling the group towards more and more courageous choices and good practices.

The steps taken by Botanic to promote biodiversity

Botanic has established 25 commitments to be achieved by 2010 in support of sustainable development. These aim to move retail businesses towards more responsible sourcing of supplies and products designed with an eye to what happens at the end of their useful lives. Botanic's strategy focuses mainly on reducing its own environmental impact, to set an example to others. These commitments include:

CHOOSING LOCAL TIMBER FOR PREFERENCE AND MAKING SURE THAT IT COMES FROM SUSTAINABLY MANAGED FORESTS

While tropical forests are being depleted, French forests, cultivated and shaped by human hands for centuries, are booming, annually producing more timber than is felled. Botanic emphasises local timber supplies from sustainably managed forests, thus lowering the energy bill attributable to the transport of traditionally imported products.

Logging in tropical regions often results in the destruction of virgin forest rich in biodiversity. At Botanic, teak accounts for a large proportion of sales and comes largely from Indonesia. To guarantee the source of its products, in 2001 the company began to rely on the Forest Stewardship Council (FSC) label, which for the following two years certified 80% of garden furniture. However, deforestation problems in Indonesia have created a shortage of FSC-certified wood. New supply sources must consequently be sought out, indicating the commitment of a company concerned for the exploitation of forests which its own operations rely on.

ECOLOGICAL GARDENING: ZERO TOLERANCE FOR FERTILIZERS IN THE SHOPS

At present almost 13 million people in France plant gardens, adding up to an area of more than 1 million hectares. This absorbs no less than 8000 metric tons of pesticides and herbicides each year. To assess the impact of these chemical compounds on the natural environment, in 2006 Botanic got the Movement for the Rights and Respect of Future Generations to establish a ranking of the eco-toxicity of the active

ingredients permitted in home gardening. One hundred of these turned out to be harmful to health, being either carcinogenic or neurotoxic.
The “Eco-Gardener” programme resulting from this research aims to reduce the impact of gardening on the environment and on health. It means not polluting water, air or soil, while attempting to reduce consumption and the production of waste: this helps to preserve the gardeners’ health and to promote biodiversity in the garden. All artificial fertilizers and chemical pesticides were removed from the shops on 1 January 2008.

THE PROMOTION OF ORGANICALLY GROWN PRODUCTS

“zero pesticide” policy, Botanic chose to influence modes of production by only buying organically farmed foodstuffs. The dependence of conventional modes of production on petrochemicals is a threat to biodiversity, and the cost of water pollution over the long term is more expensive than treating the problem at source. In March 2008, 5 shops were already offering an “organic market”. These will be increased to 15 by the end of 2008, the goal being to actively encourage the growth of this market. In the other shops, the gourmet product range (gingerbread, honey, jams) has been organic since January 2008.

Organically grown foodstuffs on the shelves

Environmentalist bookshop

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2.1.1

groupecarrefour

Over the last 40 years the Carrefour group has become a leading distributor around the world. Today it features four main types of shop which combine food and non-food sales under one roof: hypermarkets, supermarkets, discount and convenience stores. A pioneer in developing countries, the group is active in three major markets: Europe, Latin America and Asia. With a presence in 30 countries, more than 54% of its sales come from outside France. Depending on the country, over 80% of the products on its shelves come from local producers and manufacturers.

In 1992, when Carrefour's first Filières Qualité were launched, the idea of sustainable development was not yet widespread. However, its principles were already central to the corporate culture and strategy of the group. Ever since then, Carrefour has continued to strengthen this approach.

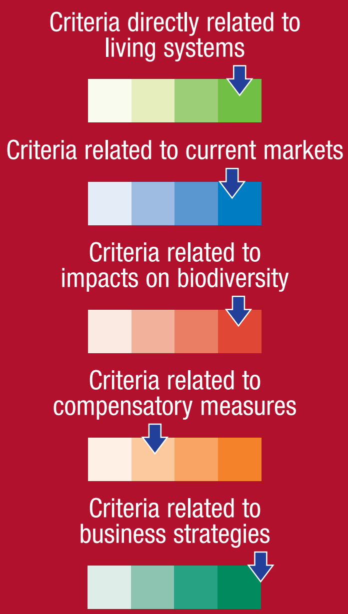
To manage and reduce the environmental impact of its shops (consumption, water, energy, coolants, waste, paper), Carrefour relies on an explicit policy and on key performance indicators. These enable it to monitor its consumption, to measure progress in each country where it operates and to draw up an action plan to

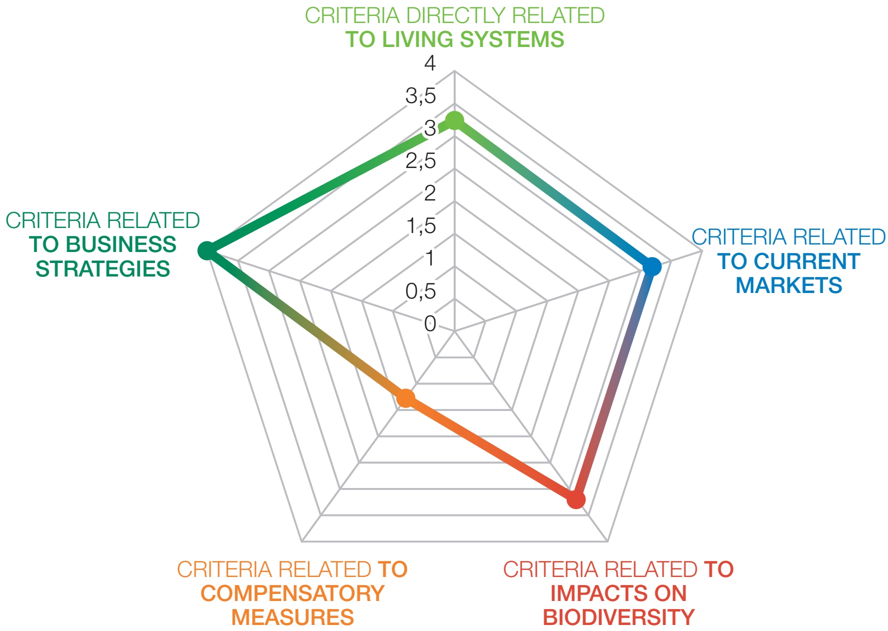
- Optimize energy and resource consumption at the individual store level;
- Manage waste and promote recycling;
- Manage impacts associated with the transport of goods and people.

CARREFOUR IN FIGURES

- Sales of **102.442 billion** € in 2007 (all shops)
- **Number 1** retailer in Europe and **Number 2** world-wide
- Close to **15,000** shops in **30** countries, directly operated or franchised
- **490,042** employees world-wide
- More than **3 billion** checkout transactions annually

SELF-ASSESSMENT





> *Standing behind the quality and diversity of its products, Carrefour promotes organic farming, responsible fishing and support for small producers both through its own brands and by dealing with local suppliers.*

THE INTERDEPENDENCE OF CARREFOUR WITH BIODIVERSITY

SUMMARY OF THE INTERVIEW WITH *ORÉE* ABOUT THE BUSINESS AND BIODIVERSITY INTERDEPENDENCE INDICATOR

CRITERIA DIRECTLY RELATED TO LIVING SYSTEMS

Dependence on raw materials derived from living systems

Raw materials derived from living systems, including foodstuffs, textiles, paper and furniture, are tightly linked to the retail sector, which markets considerable quantities of these resources every day. The consumption of fossil resources is particularly significant in the case of product packaging, transport and delivery of merchandise for a group operating on an international scale.

2.1.1

Dependence on services and technologies from living systems

The need of water supplies for agriculture and fish farming, which our outlets rely on indirectly or directly (fishmongers), is an example of Carrefour's direct and indirect dependence on **ecological services.** The agricultural sectors are also dependent on **support and regulatory services** which underpin the production of foodstuffs sold to the company. While **eco-mimetism** is not of immediate relevance, it may well be relevant to some of its agricultural suppliers.

Fruit and vegetables on display: biodiversity is key to household consumption

Management of the variability, health and complexity of ecosystems

The **unpredictability of the environment** is often a source of constraints for the company. Its products are subject to strict specifications, and significant differences in standards or production methods are not permitted. However, for seasonal products, variability can be a source of opportunity for product diversification. **Healthy ecosystems** will provide more raw materials than degraded environments. When they function properly, this affects production expenses and reduces the risk of shortages and the resulting extra costs, for example if foodstuffs come from a supplier who is farther away or more expensive. The **complexity of ecosystems** is also seen as a constraint. Careful selection of products leads to standardisation, particularly with respect to colour and shape, and to the streamlining of production techniques, such as vegetables grown hydroponically. This approach responds to consumer expectations, and to call it into question requires significant investment, both in technological and organisational innovation and in changing attitudes both internally and in the minds of the public. Since 1992 Carrefour has been building up new, more accountable, sources of supply for its Quality Lines and other branded product lines.

CRITERIA RELATED TO CURRENT MARKETS

The **cost of raw materials derived from living systems** is difficult to assess. It can change from year to year, depending on the source, quality and availability of the product. With respect to **market positioning,** some brands and product lines (organically grown, responsible fishing) are significant selling points for Carrefour. In offering a wide range of products derived from living systems, a considerable proportion of its sales are connected with biodiversity.

CRITERIA RELATED TO IMPACTS ON BIODIVERSITY

Many initiatives have been launched to combat **pollution**, such as waste management and the reduction of greenhouse gas emissions, as well as the elimination of wasteful packaging and plastic bags and the sorting and recycling of rubbish in the shops. The **reversibility of the company's impacts** on biodiversity is difficult to assess, since it chiefly has to do with the operations of its suppliers. We need to separate out the impacts of suppliers in the areas of agriculture, forestry and fisheries from those associated with the operation of our shops. In the latter case, we are making increasing efforts to integrate our buildings into the surrounding landscape via the use of appropriate building materials and vegetated roof cover. The focus today is on indirect impacts, that is, those of our suppliers, with respect to **environment fragmentation** and **selective pressures** on species distribution and survival.

CRITERIA RELATED TO COMPENSATORY MEASURES

Carrefour is not concerned with **compensatory measures,** legally required or otherwise. The company seeks to avoid or reduce its indirect impacts, that is, those of its suppliers.

CRITERIA RELATED TO BUSINESS STRATEGIES

For quite some time Carrefour has been working to minimise its **impact on the natural** environment and biodiversity. This is both a matter of good citizenship and an insurance policy for the continuance of its operations over the long term. Its concrete initiatives in support of the environment are published in an annual "sustainable development" report, which is essential, in both **in-house communication** and **public relations,** to promote the image of a group with a responsibility to its customers. Biodiversity presents the company with a dual challenge: (a) it is vital for its products, that is, its sales, and (b) it concerns both the direct and indirect impacts of its operations. Despite the initial extra costs it imposes, biodiversity can be a source of **competitive advantage.** By being attuned to public opinion, the group has been able to anticipate new trends: in 1997 the Carrefour Bio product range was launched and it now sells fair trade products. The aim is to develop long-lasting partnerships with its suppliers. Through this strategy customers can get the best value for their money. "Sustainable development" is not an isolated issue for Carrefour but an attitude, an aspect of its **corporate culture** that is shared by everyone. It is at the core of the organisation, and of each of its activities.

2.1.1

1992

Launch of the "Filières Qualité Carrefour"

1996

Implementation of the precautionary principle with regards to GMOs

1997

Birth of "Carrefour Bio"

The steps taken by Carrefour in support of biodiversity

Carrefour's commitment to the environment arises out of its need to reconcile sustainability and the use of resources supplied by living systems. Since 1992, the company has been introducing Quality Lines products, now identifiable with the Engagement Qualité Carrefour logo: these are subject to strict criteria of quality, traceability and respect for the environment and also promote local development. In 1996, the company decided to apply the precautionary principle and thus exclude genetically modified organisms (GMOs) from its products. It continues to offer customers an alternative to products derived from transgenic materials. In 1997, the first organically grown products under its own Bio brand appeared and are now available in ten countries.

OUR GOAL: RESPONSIBLE SOURCING

Promoting responsible fishing

In 2005, Carrefour launched the "Responsible Fishing" product range in France and Belgium. This ensures optimal traceability and proper management of fish stocks. In its seafood departments the company has decided to promote herbivorous species, to minimise the number of wild species it carries and to buy shrimp farmed by members of the Global Aquaculture Alliance. It plans to introduce several products with the Marine Stewardship Council guarantee in its Hypermarchés France by early 2008, and three products with the Carrefour Agir Eco Planète label (salmon and Alaskan hake) are scheduled for September. Not all the sourcing of the wild species we carry is guaranteed environmentally sound; however, the efforts already under way reflect the company's determination to preserve threatened fish stocks.

Fish stocks are threatened: consume responsibly!

2005

Launch of the "Responsible Fisheries" range of products

2006

AGIR Carrefour

Launch of the "Carrefour Agir" range of products

2007

Engagement to reduce the Group's energy consumption by 20% by 2020. (vs. 2004)

Wood sourcing

Carrefour has been working to improve the management of its wood sources since 1997; since 1998 it has been working with the WWF on the development of FSC-certified wood. In 2006 the company decided to stop selling teak, extending this ban to keruing the following year. This proactive approach was established in 2006 in several European countries, including France, Belgium and Italy. The company is seeking to promote FSC-certified amburana, eucalyptus and acacia for the manufacture of garden furniture in its primary European markets. 100% of the garden products sourced from its international central purchaser and sold in Carrefour shops are traceable: 80% are FSC-certified and 20% follow the guidelines proposed by the Vietnam Forest and Trade Network (VFTN). Carrefour also supports the fight against the illegal trade in wood and the introduction of methods for tracing illegal products. In 1997 the company made a commitment to refuse to do any business in Burma.

Sourcing guaranteed products: putting the consumer on the right track

In order to encourage more responsible patterns of consumption, Carrefour has introduced environmentally friendly product lines in all its outlets. These include foodstuffs and textiles (under the Carrefour AGIR Bio, Champion Bio, Grand Jury Bio labels), hygiene products, stationery and garden furniture identified with the European eco label. Other products are labelled NF environment, FSC and PEFC, and form part of the Carrefour AGIR Eco Planète or Champion Eco Planète product lines. Fair trade foodstuffs, general merchandise and textiles are identified as Carrefour AGIR Solidaire or Champion Equitable. In France, Carrefour Bio products are guaranteed by ECOCERT, an independent certification authority. Carrefour hypermarkets today carry 6,700 organically grown products, including 16% under its own brands.

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2.1.1

Founded in the late nineteenth century, Crédit Coopératif joined the Banque Populaire group in 2002. It differs from conventional banks in its co-operative structure, its close ties with non-profit organisations and, more generally, its involvement with organisations active on social and economic issues and its commitment to environmentalism.

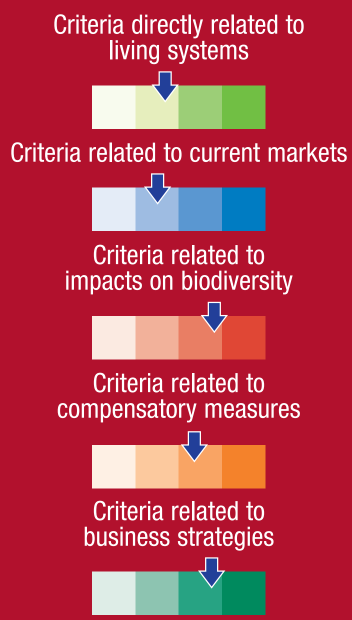
Crédit Coopératif has a presence among many companies in the environmental sector, including rubbish processing and recycling, energy management and renewable energy production. Its clients are also nature conservation organisations active in the promotion of renewable energy and preservation of plants and animals in France and in developing countries.

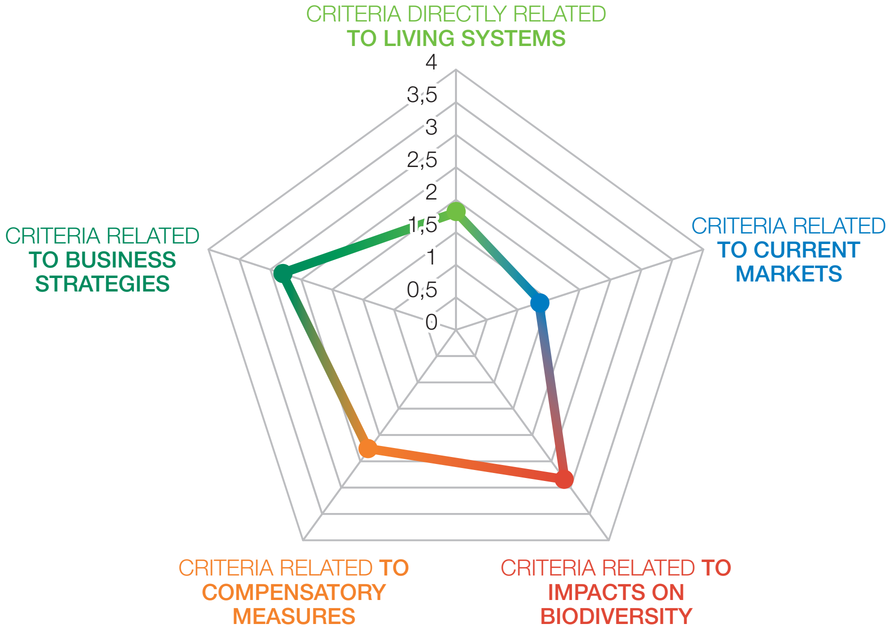
Taking biodiversity into account is a new concern for the banking sector. Crédit Coopératif, which is already aware of other environmental challenges, is now considering what means and tools may be available to give it a major role in the conservation of biodiversity.

CRÉDIT COOPÉRATIF IN FIGURES

- Net sales of **87.8M** €
- Net banking income of **346M** €in 2007
- Un produit net bancaire de **346 M €** en 2007
- **31,300** co-op members and **1,810** salaried staff **101** branches

SELF-ASSESSMENT





> *Deeply committed to businesses and organisations which are active in sustainable development, Crédit Coopératif needs to broaden its range of banking tools to encompass biodiversity.*

THE INTERDEPENDENCE OF CRÉDIT COOPÉRATIF WITH BIODIVERSITY

SUMMARY OF THE INTERVIEW WITH *ORÉE* ABOUT THE BUSINESS AND BIODIVERSITY INTERDEPENDENCE INDICATOR

CRITERIA DIRECTLY RELATED TO LIVING SYSTEMS

Dependence on raw materials derived from living systems

Purchase of office supplies is one example of the relatively minor direct dependence of Crédit Coopératif on **resources from living systems.** Its indirect dependence is more substantial: this arises in the case of the taking in of savings and the provision of financing to a variety of industries whose operations are closely connected with living systems, such as the food sector. In the case of **living systems from past eras,** the consumption of fossil fuels by its employees' travel in France and abroad is

2.1.1

significant. This dependence also varies indirectly depending on the various activities and energy expenditure of both the co-op members and the companies included in its investment portfolios.

Dependence on services and technologies from living systems

The relationship of a bank to **ecological services** is difficult to define explicitly. These concepts, newly introduced into the world of finance and insurance, are still unfamiliar to employees and have not yet been integrated into Crédit Coopératif's strategies. However, the taking in of savings and financing of activities closely connected with ecological services, **biotechnologies** and **biomimetism,** such as the lumbering and sewage treatment sectors, constitute indirect involvement by the bank in these areas.

Management of the variability, health and complexity of ecosystems

These criteria are more relevant to the bank's clients. Lending decisions are chiefly based on risk analysis, focusing on the financial health of the company concerned. In the last few years this analysis has been expanded to include environmental risks. Clients can be affected by the **variability of ecosystems,** with varying consequences for their sales figures, their liabilities and, ultimately, their profits. With respect to the **health** and **complexity of ecosystems,** it would be interesting to see which parameters and variables make a co-op member or company more vulnerable, with a view both to managing risk to the Crédit Coopératif and to offering appropriate new financial products or services. For example, a business reliant on high-quality water resources, such as organic farming, would find its financial health deteriorating if that resource were to be contaminated by the spread of pollution.

CRITERIA RELATED **TO CURRENT MARKETS**

Raw materials derived from living systems purchased by Crédit Coopératif do not account for major **costs.** Similarly, banking instruments with implications for the environment represent only a **small proportion of sales.** On the other hand, Crédit Coopératif's operations rely indirectly on the connections its clients (co-op members, companies) have with the fabric of living systems. While **market positioning** is increasingly linked to environmental issues, it is difficult to foresee what position will be assigned to biodiversity in the medium term in the bank's business strategy.

CRITERIA RELATED **TO IMPACTS ON BIODIVERSITY**

The majority of bank branches are situated in urban centres. The **impact of these buildings** on the natural environment is certainly **irreversible.** New branches continue to be built in urban areas, meaning that to describe this construction as **"changing the landscape"** is inaccurate; the focus is rather on the effective integration of new buildings into their surroundings. The Crédit Coopératif plans to follow an 'HQE' (Haute qualité environnementale) approach in the rebuilding of its headquarters in Nanterre. With respect to causing **pollution,** while employee travel is a source of greenhouse gas emissions which ought to be reduced, the Crédit Coopératif is not directly responsible for the impacts on ecosystems due to its member clients or to the companies in which it is a shareholder. Pilot projects are being pursued to encourage environmentally responsible behaviour through subsidised loans for investments which contribute to conservation. The support given to member clients involved in reducing their impacts forms an indirect but essential contribution to the future of the biosphere.

CRITERIA RELATED **TO COMPENSATORY MEASURES**

Although the Crédit Coopératif is not affected by **regulatory compensation,** it is gradually introducing financial mechanisms to compensate for damage to biodiversity, a measure which could affect many of its member clients. The bank is currently **working on finding tools** for reducing greenhouse gas emissions: the challenge would be to expand these to address the challenges posed by biodiversity.

CRITERIA RELATED **TO BUSINESS STRATEGIES**

As a socially responsible and ethical bank, the Crédit Coopératif is sensitive to the need to respect the environment. **In-house communication** and **public relations** on the topic of "sustainable development" is expanding, particularly in response to the **expectations of its member clients** and the **general public.** Biodiversity, a source of both risks and opportunities, can generate **additional costs** if it means taking longer to process dossiers. The bank today needs to distinguish itself from its competitors, by providing assistance and banking tools which encourage its clients to opt for practices supporting biodiversity: that is, **expanding and adapting the existing range of products and services,** including special types of loans and savings products developed in partnership with the non-profit organisations among its clients.

2.1.1

The steps taken by the Crédit Coopératif to promote biodiversity

The Crédit Coopératif's involvement in environmental issues is expressed both by the reduction of its own impact on ecosystems and the development of innovative tools for assisting its customers to take their own steps in this direction.

ENCOURAGING ECO-FRIENDLY PRACTICES AMONG ITS OWN STAFF, A FIRST STEP TOWARD LIMITING THE BANK'S IMPACTS ON ECOSYSTEMS

Beginning in April 2007, the sorting and recycling of paper and cardboard and the collection, removal and recycling of ink cartridges and toner have been established policy at company headquarters, in partnership with a contracting company. The cleaning products used by the bank are also environmentally neutral. This policy will gradually be extended to all the branches in the Ile-de-France.
In 2008, the Group plans to introduce carbon accounting for its activities.
The plan is to offset the CO_2 emissions generated by the travel undertaken by participants attending regional meetings. As of now, the entire fleet of company cars has been replaced, and environmental criteria are now intrinsic to the bank's purchasing policies.
Along the same lines, a challenge for the future will be to reassess policies relative to the sourcing of resources from living systems. How can we place orders for paper or furniture without damaging biodiversity?

THE CRÉDIT COOPÉRATIF'S ENVIRONMENTALLY POSITIVE FINANCIAL TOOLS

The Crédit Coopératif develops products which can add an environmental dimension to saving and support individuals, businesses and non-profits in investing in areas which contribute to preserving the environment:

- PREVair loans are issued at preferential rates to finance expenditures by individuals on their "eco-habitat", such as wood stoves, solar power or geothermal installations or equipment for collecting rainwater, and also environmental investments by businesses and non-profits, using the resources of the CODEVair savings plan.
- The savings plan of the Gamme Agir pour l'environnement offers investors the option to donate 50% of the interest accrued to various organisations working for biodiversity. Among these are FNE,

the Surfrider Foundation, Terre et Humanisme, WWF, Bioconsommacteurs and Echomer. With its Carte Agir, the Crédit Coopératif contributes 3 Euros at sign-up and 0.06 Euro for each withdrawal from an ATM machine to France Nature Environnement.

WHAT ARE THE PROSPECTS FOR BIODIVERSITY?

So far, the financial sector has focused on issues related to climate change (carbon offsets), and other primary aspects of the social responsibility of business, such as human rights or waste disposal and water management. For the Crédit Coopératif, the emerging challenge posed by biodiversity is perceived in two ways:

- As a source of risk through the environmental liabilities of the member clients and companies it finances;
- As a source of opportunities through the development of new banking products and services to help and support its clients as they confront this new challenge.

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2.1.1

Dervenn is a company located in Brittany, north of Rennes. Originally a group of specialised intervention teams, in 2004 the company added a consultancy division in order to meet the specific requirements of contractors.

The company carries out both preliminary studies and construction in connection with the designing of new ecosystems. Its expertise falls into three complementary divisions:

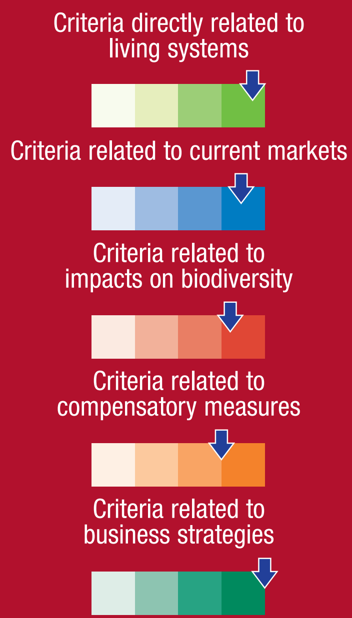
- A "preliminary study and engineering" division with technical expertise in managing water, environments and wetlands ;
- An "intervention" division consisting of two or three experts in the management and protection of natural environments, using methods appropriate to sensitive areas to implement effective action on the targeted ecosystems ;
- A "research and development" division which is essential for innovation and for maintaining a solid base of up-to-date knowledge relevant to the implementation of its projects.

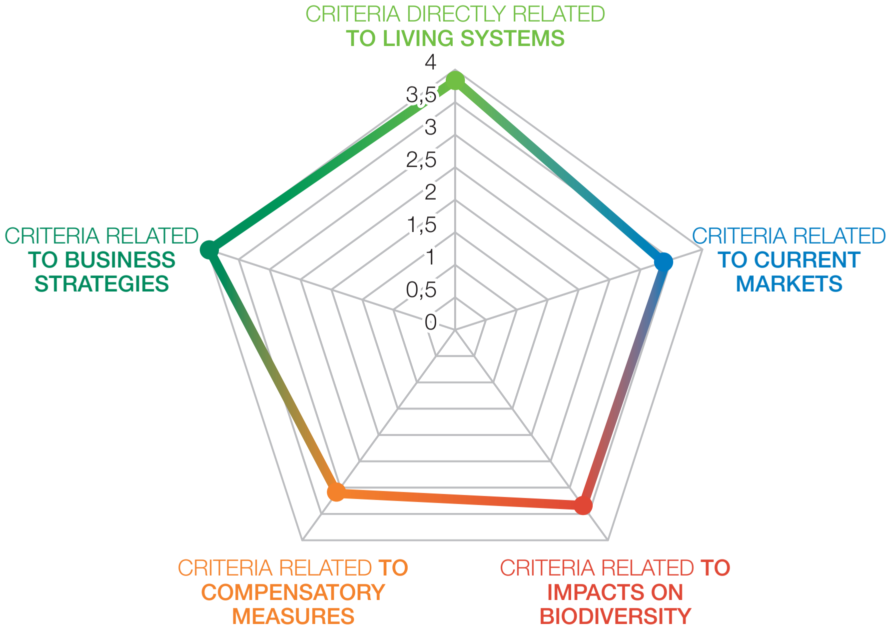
Before 2007 Dervenn operated purely in the public sector. Now it also offers its services to landowners seeking to enhance the living systems in their care, companies seeking to reduce their environmental footprint and planners seeking to integrate living systems into their infrastructure projects.

DERVENN IN FIGURES

- Sales of **1M** € in 2007
- **150,000** € for research and **850,000** € for construction
- A team of **20** salaried staff, including environmental engineers and technicians
- Founded 15 August 2002

SELF-ASSESSMENT





> *Nature is Dervenn's chief client.*

THE INTERDEPENDENCE OF DERVENN WITH BIODIVERSITY

SUMMARY OF THE INTERVIEW WITH *ORÉE* ABOUT THE BUSINESS AND BIODIVERSITY INTERDEPENDENCE INDICATOR

CRITERIA DIRECTLY RELATED **TO LIVING SYSTEMS**

Dependence on raw materials derived from living systems

Working with living systems is at the heart of Dervenn's operations. Its direct dependence on **living systems** takes the form of the horticultural products to be used in environmental restoration projects. Working the land also requires the use of machinery which consumes **fossil resources,** as does travel by its employees around France.

2.1.1

Dependence on services and technologies from living systems

Restoring, rehabilitating or creating habitats presupposes a solid knowledge of the functioning of ecosystems and their component subsystems. **Ecological services** are vital to performing the work and intrinsic to the purpose of the projects. The desire to maintain and restore these services is constant, especially with respect to work involving rivers or wetlands where water purification by micro-organisms is essential. **Biotechnologies** also form part of the company's operations: the reduction of nitrate pollution by plants or the reinforcement of riverbanks by fascining are good examples. Restoration techniques encourage the natural reappearance of biodiversity, for example replanting meadows with flowers which attract the bees needed to pollinate plants.

Management of the variability, health and complexity of ecosystems

Variability is an essential factor in working with ecosystems. A number of bio-physico-chemical parameters are studied prior to the start of any project and monitored throughout its course, while more long-term climate change and **ecosystem variability** are issues of concern to the R&D division. What will be the condition of these environments in years to come? Should a particular choice of species be made accordingly? An analysis of specific local conditions is an essential prerequisite for selecting the most appropriate working methods while assisting the development of ecosystems. Consistency is crucial in any approach proposed to clients. **Ecosystem health** is a basic criterion for the selection of tree species. The issue is to avoid contributing to invasion by non-native species, for example by promoting regulatory interactions among species. Engineers and teams in the field are aware of the importance of the functional dynamics of habitats and their component parts. To promote, create and rebuild these is the task confronting the ecology of restoration and landscape: to recreate interfaces and discontinuities which promote the **diversity of living systems in all their complexity.**

Habitat restoration begins with large-scale re-landscaping

CRITERIA RELATED TO CURRENT MARKETS

Although raw materials derived from biodiversity account for only **minor costs,** the diversity of living systems determines the **range of services** the company offers. **Market positioning** is completely centred on biodiversity, as expressed in the company slogan, "Dervenn - environmental engineering and biodiversity". The primary beneficiary of our activities is not the client who contracts the work but nature itself.

The relationship between the human and natural worlds is a key concern for Dervenn

CRITERIA RELATED TO IMPACTS ON BIODIVERSITY

Reversibility is a very important concept in environmental engineering. Dervenn views it from two angles. First of all, environmental engineering is about changing an environment in a deteriorated or undesirable state to a benchmark state, which is often difficult to define clearly in the case of dynamic and evolving ecosystems. Secondly, rehabilitation and the creation of new ecosystems proceed by way of a drastic **transformation** of the environment to guide it in the direction of a new ecological goal. Although **changes** in soil structure, canopy and waterways are inevitable, the final product is a new habitat characterised by thriving biodiversity. In other words, the goal is to create environments rich in biodiversity, **promoting species mobility** by opening up environments and creating ecotones and species mosaics. Dervenn's impacts on biodiversity are thus positive.

CRITERIA RELATED TO COMPENSATORY MEASURES

Dervenn's expertise is centred on the principle of compensation. The services offered to local governments and companies are designed to meet their need **to offset the residual impacts** of their operations and development projects. As well as the restoration of degraded sites, the company offers the creation of new habitats, with the goal of increasing the biodiversity of the site in question. This approach goes **beyond what is required by law.**

CRITERIA RELATED TO BUSINESS STRATEGIES

Biodiversity is at the heart of the company's own development strategy. It is by establishing a rigorous scientific and ethical foundation and providing systematic, tailored services to its clients that it expects to become **competitive** in the field of the restoration of biodiverse areas. In a time of growing community pressure and new regulatory constraints, everything points to the increasing importance of biodiversity in land management, as for example in the "green" and "blue" threads proposed for land and waterways in France. For environmental engineering to be undertaken in the field, convincing clients of its value requires very **effective communication techniques:** it is often difficult to commit to landscape development projects scheduled to last for several decades, although this is the shortest possible time scale in the case of living systems (the life-span of an oak tree). For Dervenn, bringing its clients to positively want an area rich in biodiversity constitutes both a challenge and a **new market,** which arises from the promotion of the value of the natural world whether in one's own home or on the surrounding terrain. Everyone can enjoy this benefit, tangible or otherwise, in the same way that they enjoy owning a nice car. The success of this approach is determined by the company's own **corporate culture:** knowing that they are working to preserve heirloom species and to satisfy customers who value biodiversity is a real motivator for the staff.

2.1.1

The steps taken by Dervenn to promote biodiversity

ENVIRONMENTAL ENGINEERING: FROM THE RESTORATION OF NATURAL ENVIRONMENTS TO THE PROMOTION OF BIODIVERSITY

Rebuilding a natural environment means re-establishing optimal conditions for the development of animal and plant communities, while also allowing for human activity and use. The animal and plant populations which make use of the restored or recreated natural infrastructure are Dervenn's true clients. Environmental engineering is the equivalent of civil engineering for populations of living things. Our mission is to develop the functioning infrastructures which are a prerequisite for the development of life. The goal is to optimise the conditions of the natural environment, focusing on ecological resilience and increasing the likelihood of further development. This innovative method is designed to recapture centres of biodiversity throughout the country.

The intention behind this approach is to offer effective and practical methods. Depending on the initial condition of the area, there are three possible levels of intervention:

- Restoration
- Rehabilitation
- Reassignment

In all three cases, the goal is similar: the creation of areas in which life can develop in the most diversified way possible for every kind of living organism, from genes to whole ecosystems.

PROCEDURE FOR BRINGING BACK NATURE

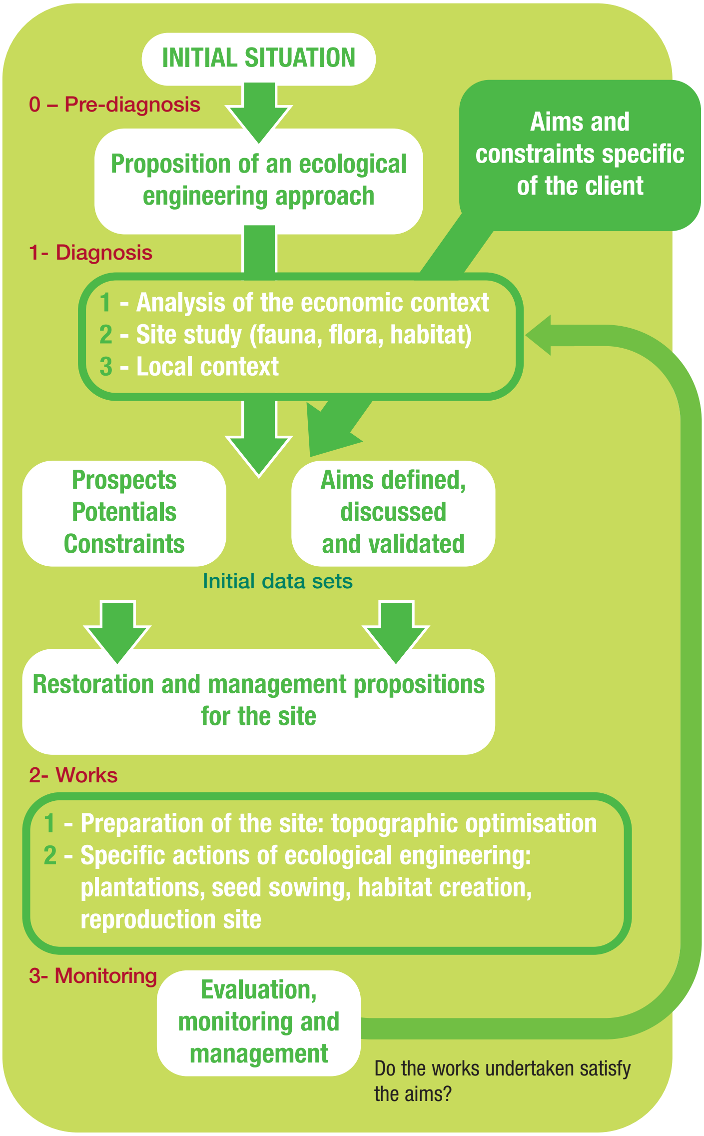
The procedure recommended for any land area involves a systematically organised body of research results and analyses, followed by intervention and monitoring, coupled with communication, dialogue and education.

Restoration, rehabilitation and reassignment can take place in a three-stage process:

Site assessment: this is based on the study of the socio-economic and ecological possibilities and limitations of the site. It leads to a determination of the environmental engineering operations to be implemented and includes an intervention plan comprising the description and schedule of operations. It also determines the cost of the various operations to be carried out over the long term. This step is completed with a preliminary diagnosis presented to the client.

Implementation: this stage follows the proposals generated in the first stage. The methods employed are suited to the limitations and possibilities of the environment in question and are implemented by teams with specialised skills. This stage includes in turn the redevelopment of the terrain and replanting, introduction or improvement of wildlife habitat, as well as observation blinds and other educational features.

Monitoring and management: in the short, medium and long term, the monitoring of the project is based on indicators of biodiversity put in place during the first stage. Corrective actions may be undertaken depending on how the environment changes over time. The ultimate goal is to make an ecosystem that is sustainable and self-sufficient over the long term; hence the importance of this long-term monitoring process for measuring the efficiency of the project.



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2.1.1

Electricité de France (EDF) is a European leader in the energy field, active in all aspects of the electricity business from generation to sales and systems management. Before November 2004 it was an Établissement Public à caractère Industriel et Commercial (EPIC), but it has since changed its legal status to that of a public limited liability company in which the state is a shareholder.

The company focuses primarily on nuclear power, with 58 reactors in operation. In France, nearly 88% of the electricity produced by EDF comes from nuclear power.

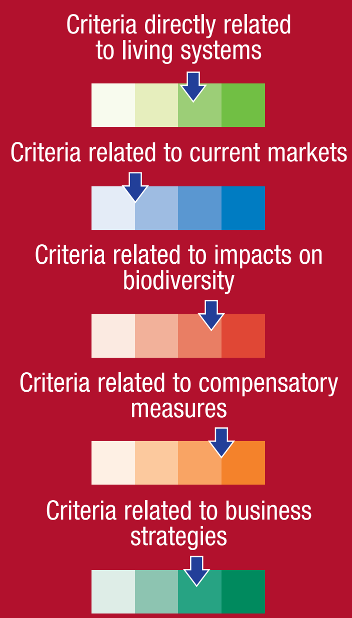
Since its operations affect the whole country, EDF has long been concerned with environmental issues. In 2006 it established a specific policy on biodiversity, as part of its overall environmental management system. These new provisions are a stronger indication of its readiness to go beyond the commitments undertaken previously. They are focused on three objectives:

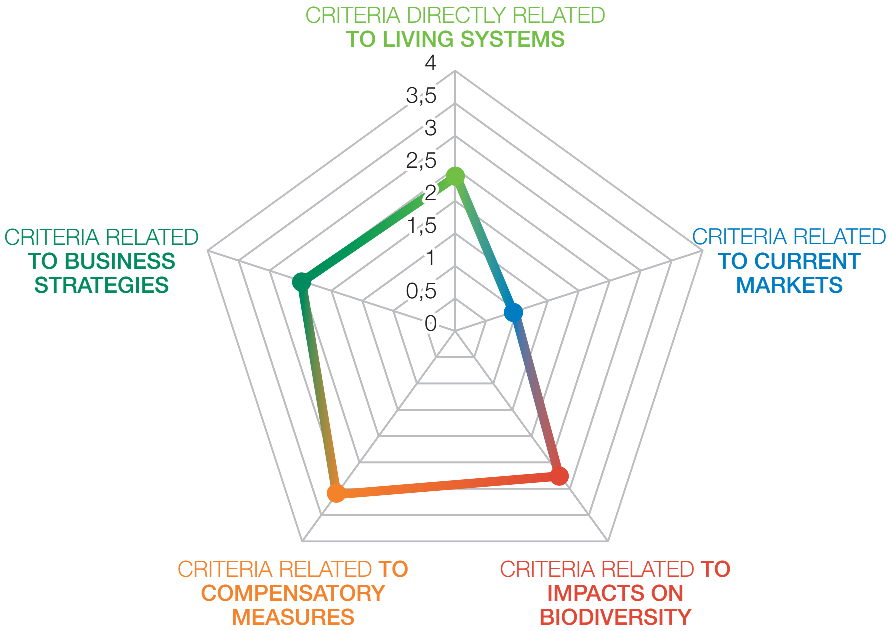
- To improve its knowledge of environments, for both impact assessment and reporting;
- To preserve, protect and restore the environments with which EDF interacts;
- To inform, educate and raise public consciousness.

ELECTRICITÉ DE FRANCE IN FIGURES

- Sales of **59.6 billion** € in 2007
- **610.6 tWh** of electricity generated
- **158,640** employees in 2007
- **38.5 million** customers within Europe

SELF-ASSESSMENT





> *With a strong pro-biodiversity policy, introduced in 2006, Electricité de France has made a long-term commitment.*

THE INTERDEPENDENCE OF ELECTRICITÉ DE FRANCE WITH BIODIVERSITY

SUMMARY OF THE INTERVIEW WITH *ORÉE* ABOUT THE BUSINESS AND BIODIVERSITY INTERDEPENDENCE INDICATOR

CRITERIA DIRECTLY RELATED TO LIVING SYSTEMS

Dependence on raw materials derived from living systems

Dependence on **raw materials derived from living systems** occurs at two levels: the purchase of (a) fossil fuels such as gas and coal for the thermal power stations and (b) various items for the administrative departments, such as paper, furniture and foodstuffs (meals, coffee). EDF also depends on **petroleum products** for staff travel.

2.1.1

Dependence on services and technologies from living systems

Water is an **ecological service** on which EDF relies heavily, for thermal and nuclear power and for hydropower. The ecological health of catchment areas and the volume of river flows are crucial factors in continuing electricity generation. EDF influences the quality of this resource by treating the outflows of water from its stations. The company is engaged at present in extensive discussions of **industrial ecology,** analysing possible synergies between inflows and outflows from businesses sited close to its generating stations. A database, Editerr, has been designed with this in mind. Partnerships have been formed with cement, concrete and construction companies, which now use gypsum and ash from thermal power stations. We may also note that uranium deposits, a crucial resource for the production of nuclear power, are the product of a redox produced by a type of bacteria.

Management of the variability, health and complexity of ecosystems

Seasonal and temperature variation affects the production and consumption of power. Variations in the biochemical parameters of water have a greater effect on the management of discharges from power stations. In a longer-term perspective, research into the potential impact of climate change are central to discussions. Modelling changing temperatures and river flows is crucial for predicting future hazards and developing appropriate tools for future conditions. The R&D division has been inspecting and studying rivers for the past 20 years, and constantly monitors the **health of the ecosystems** in which EDF operates. Silting up, a problem which often occurs upriver from hydropower dams, can generate extra costs of dredging. Limiting erosion in the catchment area using environmental engineering techniques should avoid the need for industrial dredging methods. The concept of the **complexity of ecosystems** is especially relevant to hydroelectricity generation, where the parameters, such as water quality, the volume of river flow and invasive plants, are not always controllable.

CRITERIA RELATED **TO CURRENT MARKETS**

The **costs associated with raw materials derived from living systems are substantial.** They vary depending on the price of gas, coal and biomass. However, these costs should be seen in proportion to that of investment in power stations and of payroll. As already noted, the **generation of power,** both fossil and nuclear, is closely linked to living systems. The recent creation of a biodiversity policy is an asset with respect to **marketing,** helping to position living systems more firmly at the centre of environmental considerations.

CRITERIA RELATED **TO IMPACTS ON BIODIVERSITY**

The generation of electricity and its delivery to individual customers, via the power-station to high-voltage power lines to private home sequence, requires a network of installations scattered around the country. Through innovative techniques, some of these facilities can be redesigned to be **more in keeping with the landscape.** This is also one of the challenges facing new installations. EDF also aims to reduce its **impacts on species;** however, bird activity can sometimes be disturbed by the presence of power lines and dams can present obstacles to the seasonal migration of fish species. Although the **generation of pollution** occurs mainly in the area of transport, indicators are employed to measure the carbon impact of all EDF's operations. Moreover, **habitat fragmentation** is an inevitable result of the siting of power transmission facilities. The production of hydropower also disrupts the “blue thread” of the waterways. It is possible to minimise these impacts through appropriate design of these installations.

CRITERIA RELATED TO COMPENSATORY MEASURES

The European Union Water Framework Directive has established as an objective that all surface waters should achieve "good status" ecologically by 2015. The R&D teams have performed a comprehensive review of the implications of this Directive for EDF's power stations. While its rules represent **new constraints** in some respects, they have enough flexibility to allow for balancing the needs of nature conservation and energy production. The company also shares the agreed objectives for the protected areas and Natura 2000 sites in which it has a presence, and follows the guidelines for the construction of new facilities.

In the last 20 years, the construction of nearly 80 fish ladders on dams in France has helped to restore contacts between populations of different fish species. On the power grid, bird conservation projects take the form of perches constructed on the installations. In Laos, the construction of the Nam Theun 2 dam is accompanied by compensatory measures via the creation of a protected area upriver of the reservoir. For the last several years the EDF Foundation has undertaken **sponsorships,** funding a number of biodiversity-related projects. Partnerships have been established with the Fondation Nicolas Hulot pour la Nature et l'Homme, the Réserves Naturelles de France, the Ligue pour la Protection des Oiseaux and the Conservatoire du Littoral.

CRITERIA RELATED TO BUSINESS STRATEGIES

EDF is one of the few companies to have its own **biodiversity policy.** This commitment marks an increasingly active involvement in issues which connect the energy sector to the fabric of living systems. EDF responds to **community pressures** through partnerships with stakeholders and consciousness-raising activities which teach good practices and establish common goals. As a partner in the Fête de la Nature, the company is expanding its initiatives. Through its intranet it can network people or groups who are directly involved in these issues, providing food for thought and furthering discussion. While active involvement in questions of biodiversity does not yet extend to the entire company, given the large number of its employees, awareness is now increasing among its different teams.

2.1.1

The steps taken by Electricité de France to promote biodiversity

EDF ADOPTS A BIODIVERSITY POLICY

EDF has long been seriously committed to active discussion of the impact of its operations on living systems. Efforts have been made to improve and deepen its knowledge of endangered species and environments, so as to identify its operations' interference with the surrounding ecosystems. The company conducts its operations and discussions in partnership with the scientific community: the Institut de recherche pour l'ingénierie de l'agriculture et de l'environnement (CEMAGREF), the Institut français de recherche pour l'exploitation de la mer (IFREMER) as well as the non-profit community are among its partners. A biodiversity policy was put in place in 2006, focusing on three areas:

1- Improving our knowledge of the natural environments in which we operate

Continuously monitoring the aquatic plants and animals around our industrial sites provides longitudinal information on the impact of these installations on biodiversity. Research carried out on water quality and aquatic species at the hydroelectric dams reveals the present status and changes over time of rivers and the communities who live nearby. In-house guidelines for the protection of biodiversity will be published by EDF in late 2008.

2- Intervening on the ground

Since the early 1980s, EDF has been involved in the restoration of major fish migration routes by investing in research and design of fish ladders to minimise the impact of dams on river systems. One of the biggest fish ladders in Europe, installed at the Gambsheim dam in 2006, will allow salmon to return to a new section of the Rhine. Various projects have already been completed or are at the planning stage on several EDF hydropower sites: trout ladders, eel ladders and downstream migration passes.
Action programmes for bird species were also expanded in 2004 with the creation of the National Avifauna Committee, a national forum working together on the issue of birds and power lines. These programmes seek to limit the impact of the electrical grid, including high-voltage power lines, on bird populations.

3- Training and educating employees

In 2005, a training programme about biodiversity was developed for EDF employees on a nation-wide level. Consciousness-raising and basic education for the general public is also being pursued in partnership with the Fondation Nicolas Hulot pour la Nature et l'Homme and the Union Nationale des Centres Permanents d'Initiatives pour l'Environnement (UNCPIE). This training programme forms part of a long-term initiative which seeks to:

- Make employees aware of biodiversity issues, and train the staff responsible for assessing the competence of outside companies working on behalf of EDF, for example by avoiding nesting periods when planning the painting of electricity pylons;

- Help to inform and raise awareness among the public, educational institutions and local elected officials about biodiversity around EDF sites.

COMPENSATORY MEASURES ASSOCIATED WITH THE CONSTRUCTION OF THE NAM THEUN 2 DAM IN LAOS

The Nam Theun 2 hydroelectric project in Laos (1080 MW), whose construction began in 2005 and which should be in service by December 2009, represents a major commitment to preserving biodiversity: it is expected to set an example for environmental and social responsibility. EDF owns 35% of the capital of the Nam Theun 2 Power Company (NTPC), and is in charge of managing the construction site and operating the facility. In economic and energy terms, this is a major installation for the development of Laos and also of Thailand, the main importer of the electricity to be generated.

The project is scheduled to include a significant social and environmental component, involving the resettlement of the local population, the creation of a natural protected area (ten times larger than the actual dam impoundment) and the monitoring of water quality on the site. The Nam Theun 2 project seeks to balance the need for electricity and the preservation of biodiversity through a combination of protective measures implemented in the construction of the dam, such as aerators at the point where the water is discharged from the turbines, to restore its oxygenation level.

Over the 25 years of the EDF concession, almost US$160 million will be spent on various social and environmental measures, that is, almost 13% of the total project cost. Collaboration with international NGOs working in the area is a high priority.

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2.1.1

Gaz de France

The Gaz de France group, a major European player in the energy field, produces, buys, transports, distributes and markets natural gas, electricity and related services to its individual customers, businesses and communities.

The sustainable development policy adopted in 2004 by the Gaz de France Executive Committee organises the group's present and future operations in accordance with four overarching goals:

- To respond to the major energy challenges of today and tomorrow by managing energy and introducing innovations;
- To fulfil the group's social and environmental responsibilities vis-à-vis all its stakeholders;
- To develop responsible management and human resources practices across the entire group;
- To take an active part in the development of new areas.

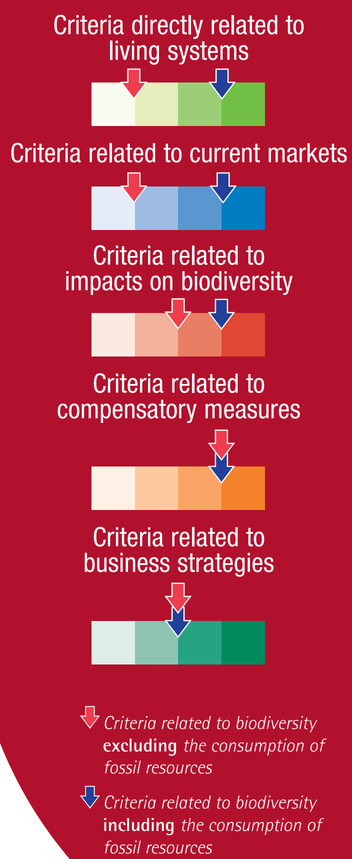
Some GDF figures for activity in support of the environment:

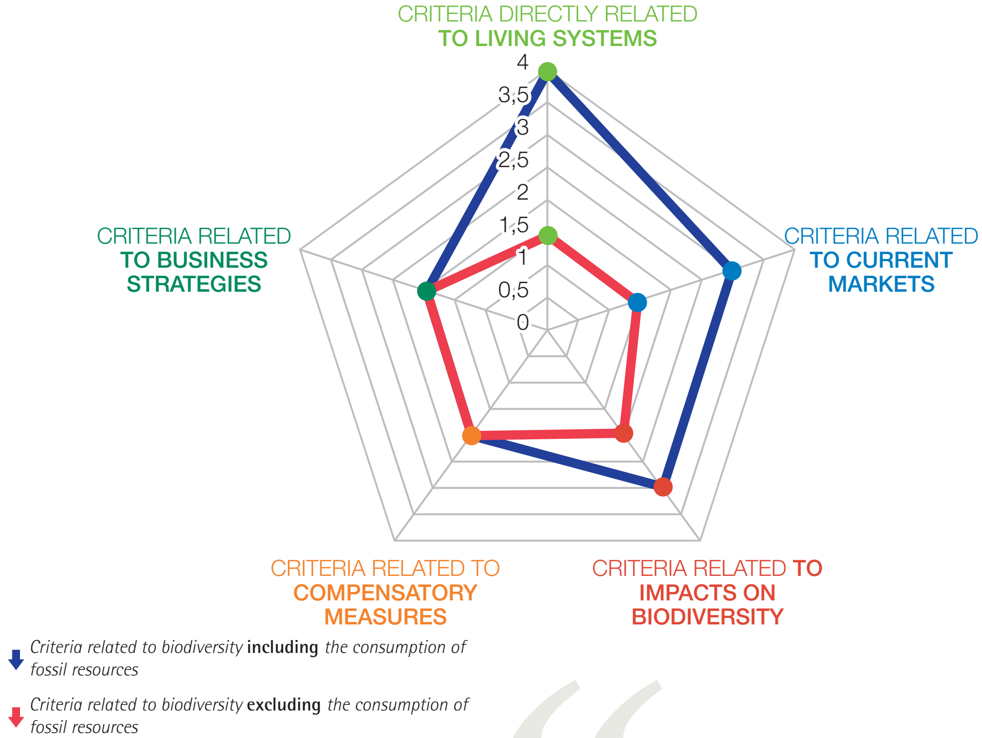
- 145 MW of wind power installed, making it the largest wind farm operator in France;
- 100% of its storage sites certified ISO 14 001;
- 76% of its R&D budget allocated to sustainable development as a matter of policy.

GAZ DE FRANCE EN QUELQUES CHIFFRES

- **27.4 billion €** in sales in 2007
- Operates in almost **30 countries**
- **47,560** associates of which **33%** were outside France in 2007
- The longest natural gas transport and distribution networks in Europe
- **3.3 billion €** invested in 2007

SELF-ASSESSMENT





"Across all its divisions, Gaz de France is committed to taking biodiversity into account in the most appropriate ways."

THE INTERDEPENDENCE OF GAZ DE FRANCE WITH BIODIVERSITY

SUMMARY OF THE INTERVIEW WITH *ORÉE* ABOUT THE BUSINESS AND BIODIVERSITY INTERDEPENDENCE INDICATOR

Given the wide variety of the operations undertaken by all the divisions of Gaz de France, thoroughly assessing and rank-ordering its various types of dependence on biodiversity is a complicated task.
While each division has concerns specific to its own operations, all are affected by the consumption of natural gas, a raw material resource derived from living systems of past eras, which accounts for the bulk of the dependence of Gaz de France on biodiversity. Within the company this particular issue - like greenhouse gas emissions - is addressed separately from biodiversity-related concerns. Therefore, two rating scales are provided for all the criteria evaluated - one including the impacts related to natural gas consumption, the other excluding these impacts - in order to better address problems specific to other issues relating to biodiversity. The criteria evaluated during this interview therefore present only a first approach to the issues, which needs to be expanded and elaborated on in future.

2.1.1

CRITERIA DIRECTLY RELATED TO LIVING SYSTEMS

Dependence on raw materials derived from living systems

Most of the company's dependence on living systems relates to our **inheritance from the past.** The exploitation of natural gas, a fossil resource, constitutes the core of the industrial operations of Gaz de France. However, the use of biomass in the heating systems operated by its subsidiaries and administrative services constitutes another form of dependence on **raw materials from living systems.** This dependence will acquire increasing importance in the coming years with the development of renewable energy sources.

Dependence on ecological services and technologies derived from living systems

The formation of natural gas reserves is an example of an ecological service. It is a natural process which benefits human populations without any intervention on their part. In this sense, the **ecological services** used by the company consist mainly of the extraction of fossil resources. To a lesser extent, the extraction of water is also required for cooling the facilities and re-heating the liquefied natural gas (LNG) in LNG terminals.

Management of the variability, health and complexity of ecosystems

The constraints related to the renewal of natural gas resources can be seen as a form of dependence on the **complexity of ecosystems.** The formation of natural gas is a slow process which takes place under highly specific conditions on a geologic time scale.

CRITERIA RELATED TO CURRENT MARKETS

Natural gas is the company's **primary sales product,** so living systems of past eras account for the bulk of its sales. Gaz de France has a **strong position in the renewable energy market,** and development in the direction of biomass energy in its operations will help diversify its dependence on gas. Moreover, in 2007 the company became the leader in the production of wind-generated electricity in France, with 145 MW installed. This new commitment will limit the reliance of its sales on living systems.

CRITERIA RELATED TO IMPACTS ON BIODIVERSITY

The construction of gas production infrastructure such as pipelines may occasionally result in habitat fragmentation. Gaz de France has invested heavily in the **integration of its physical installations into the surrounding landscape.** Putting pipelines underground reduces the **alteration of the landscape** and **habitat fragmentation** in the course of construction. Gas infrastructure can also provide opportunities for the preservation of biodiversity. Pipeline installations are being investigated at this point by the Conservatoire Botanique National du Bassin Parisien to determine whether they could be a means of preserving an ecological continuum within the Paris region.

CRITERIA RELATED TO COMPENSATORY MEASURES

Gaz de France seeks above all to avoid or reduce the impacts resulting from its operations. To complement this, compensation measures may be introduced. Even if the group is rarely subject to **regulatory obligations to compensate,** it has made a commitment through its **foundation** to several innovative initiatives, including coastline preservation, gardens and hiking trails. These compensatory actions are genuinely important. Not to implement this type of operation could incur significant financial risk, such as a resulting delay or even abandonment of construction projects.

CRITERIA RELATED **TO BUSINESS STRATEGIES**

To sustain its operations, Gaz de France has two overall policies: (1) to promote energy savings, both among its customers and in its own facilities, and (2) to diversify its operations by expanding its renewable energy production (biomass, wind power). **Dialogue** with **non-financial rating agencies** and **local residents' associations** is especially important. In the course of compensatory operations, close relationships with these stakeholders have been developed. The habitat of the ocellated lizard has been preserved thanks to joint action by the Herpetologia organisation and the subsidiary division in charge of managing the natural gas transport network. Gaz de France has brought together its dependence on living systems and the limiting of its impacts, thus helping to optimise its production system and make it **more competitive.** Active conservation of biodiversity is one means of conveying a **responsible public image.** By connecting sustainable development with access to capital from socially responsible investors, Gaz de France demonstrates a desire to acknowledge its interactions with the environment and with biodiversity.

2.1.1

The steps taken by Gaz de France to promote biodiversity

A number of recommendations for the development of a biodiversity section to be incorporated into the company's environmental policy were approved at the meeting of the Committee on Sustainable Development and Ethics in November 2007:

- To begin to map concerns related to biodiversity, in partnership with WWF France;
- To actively develop an environmental policy;
- To propose some directions for biodiversity indicators to be constructed for the reporting of performance indicators;
- To take biodiversity into account in the integrated management system and in the environmental self-assessment process;
- To establish benchmarks for future progress.

A variety of activities in support of biodiversity is under way at present, organised around key partnerships such as those concluded with the WWF in the Marais du Vigueirat and the National Museum of Natural History. These include:

- Systematic impact studies during the process of construction of new infrastructure such as the laying of a pipeline or the building of a new liquefaction plant;
- R&D projects focusing on life-cycle analysis, industrial ecology, the development of environmental performance and biodiversity indicators, and participation in the setting up of an environmental management system with EMAS certification in the Marais du Vigueirat;
- Support of the Gaz de France Corporate Foundation, which rehabilitates major symbolically significant natural sites such as the Pointe du Raz and restores neglected or threatened gardens.

GRTgaz[1], A SUBSIDIARY WITH AN ACTIVE INVOLVEMENT WITH BIODIVERSITY

Partnering for improved conservation of the natural heritage of the Ile-de-France

In December 2003, Gaz de France signed the charter of the Ile-de-France region, which addresses biodiversity and seeks to bring the region into the "Countdown 2010" network established by the International Union for Conservation of Nature (IUCN), whose aim is to halt the loss of biodiversity.

The charter proposes the setting up of a partnership involving the Ile-de-France region, GRTgaz and the National Museum of Natural History in order to study the feasibility of establishing ecological continuities on the natural gas distribution network in the region.

In consequence, in February 2007 a partnership was formed between the GRTgaz Val de Seine Region, the Ile-de-France and the National Museum of Natural History. GRTgaz embarked on a study of biodiversity in its easements in the Ile-de-France, approximately 500 km of pipeline. The Museum's Conservatoire Botanique du Bassin Parisien is in charge of the research.

(1) GRTgaz, a subsidiary of Gaz de France, manages the French natural gas distribution network.

The partnership has three main objectives:

- To take an inventory of the plant life, that is, plant species and habitats, along the sites of existing pipelines;
- To propose guidelines for managing these natural habitats so as to further the conservation of rare or endangered species and habitats;
- To investigate the contribution of these sites to the regional network of ecological continuities or biodiversity corridors.

GRTgaz hopes to expand this partnership to all the regions of France so as to establish its approach firmly and share it more widely.

The creation of the NatureParif agency

Gaz de France and GRTgaz are among the founding members of a regional agency for nature and biodiversity in the Ile-de-France called 'NatureParif'. The agency, established at the initiative of the Ile-de-France Conseil régional in October 2007, is designed to facilitate interactions between the major players in the preservation of biodiversity, including non-profit associations, economic organisations and institutions. NatureParif is a first in Europe, its mission being the expansion of knowledge about ecosystems and their functioning via empirical observation and investigation of the effect of climate change on biodiversity.

Fully integrating biodiversity into GRTgaz

In 2006, GRTgaz connected the new LNG terminal at Fos Cavaou to the pre-existing natural gas distribution network with a new pipeline. It crosses the Plaine de Crau, which is a protected natural site listed in the Réserve Naturelle Nationale. To respect the area in question, a number of initiatives have been introduced to limit the impact of the construction. These fall into several different categories:

1- Avoidance measures

The route chosen for the pipeline was that determined to have the least environmental impact, minimising habitat fragmentation by following existing surface transport facilities (main roads, canals).

2- Mitigation measures

Mitigation of impacts in the construction process was achieved through:

- Reducing the width of the work area from 24 to 20 metres;
- Sorting the topsoil;
- Laying down a suitable temporary covering to protect the coussoul, the dry scrubland characteristic of the steppe-like terrain of the Plaine de Crau;
- Arranging for the construction work to take place outside the breeding season of local species.

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These measures have helped to limit the area of coussoul involved to about 6.4 hectares of virgin land, that is, 0.66% of the total area of this habitat. The Conservatoire–Etudes des Ecosystèmes de Provence-Alpes-Côte d'Azur monitored the work. The result was a successful collaboration between the management of the nature reserve and the construction firm, thanks largely to the daily input of the operations representative from the CEEP[2] and the QHSE representative from GRTgaz, who were on site throughout the construction phase.

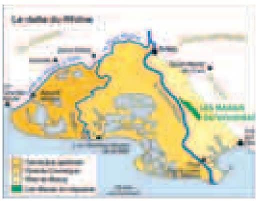
3- Compensatory measures

Among the most significant compensatory measures have been:

- The (ongoing) acquisition of areas of coussoul terrain and participation in a research programme for its restoration;
- Studies and experiments designed to identify conservation measures for the Crau native cricket;
- The return to their original location of piles of stones which form the habitat of the ocellated lizard, in partnership with the Herpetologia association;
- Studies designed to increase knowledge of the biology and ecology of the calandra lark, a highly threatened species in France, in partnership with the Ligue pour la Protection des Oiseaux;
- The funding of a research thesis in collaboration with the PACA region, the Société Anonyme de Gestion de Stocks de Sécurité (SAGESS) and the University of Avignon, on the topic of *"The ecological restoration of Mediterranean grassland ecosystems".*

ACTIVITIES IN THE MARAIS DU VIGUEIRAT, A PRODUCTIVE PARTNERSHIP WITH WWF-FRANCE

The importance of the Marais du Vigueirat



The high value of the ecosystems of the Marais du Vigueirat, a mosaic of natural wetlands typical of the Rhone delta, rich in biodiversity (especially birds), makes it a very attractive site for eco-tourism and environmental education. The Marais du Vigueirat is hoping to see 100,000 visitors a year, ten years from now. Action is consequently crucial to minimise the impact of human presence.

The Life PROMESSE partnership and programme

The Marais du Vigueirat is the "driver" of a European programme, "Life PROMESSE", dedicated to sustainable development of tourism which meshes the interests of local economies and nature conservation. The programme also aims to raise public consciousness around eco-responsibility. Direct actions of Life PROMESSE include making this natural site as 'clean' as possible, by transforming buildings and other facilities used by the general public. The resulting facilities make it possible to reduce impacts in the areas of water, energy, waste and transport. This programme brings together many partners: the association of the Amis des Marais du Vigueirat, the Arles mayor's office, the CPIE Rhône Pays d'Arles, the Conservatoire du Littoral, WWF-France and Gaz de France. It also receives support from the European Union, the PACA region, the Rhone-Mediterranean-Corsica Water Agency and ADEME PACA.

(2) Conservatoire–Etudes des Ecosystèmes de Provence Association; for more information see http://www.ceep.asso.fr/qui.htm

The Research Division of Gaz de France has also lent its technical expertise to the team of the Amis des Marais du Vigueirat, in several ways:

- Analysis of selected indicators for the EMAS project at the site;
- Advice on future solar power installations on the site;
- Procedures to be followed to connect windmills to the RTE network, based on a case study performed on micro co-generation installations.

First project strength: EMAS (Environmental Management and Audit System) certification

The Marais du Vigueirat is the first natural site in France to be granted EMAS certification. This seeks to reduce the environmental impact on the site through voluntary measures which go beyond the legal requirements. Only two other natural areas in Europe have earned this certification: the island of Maineau in Lake Constance (Germany) and the natural park of Mont Avic in the Val d'Aosta (Italy).

The EMAS method assesses the impact on the environment, defines goals and develops practical measures to reduce the negative aspects of this impact; full compliance with existing regulations is obligatory, as is the total transparency, to both the public and its own staff, of the organisation, its management and its results. An environmental management system has been established. The site and buildings have been designed in accordance with the principles of "sustainable housing", via the processing of solid waste, the intelligent management of water resources, energy conservation and the production of renewable energy. Gaz de France now collaborates with the WWF in other natural areas in a joint attempt to promote and expand EMAS certification in parks and nature reserves elsewhere in France.

Second project strength: concerted efforts to reduce the impact of activities in the vicinity of the site

The impact of activities in areas just outside the site is reduced through a process of extensive consultation with farmers and industrialists (and other socio-economically concerned groups) from the periphery of the 15,000-hectare Plan de Bourg. After a consultation conducted by the Association pour un développement solidaire in spring 2005 with local groups, and a public meeting to generate interest, a phase of discussion and construction has been initiated: today part of this population is actively involved in discussion of the development of the Grand Plan du Bourg. Four committees meet regularly to identify problems, put forward ideas for the future of the area and propose specific initiatives.

Plans for the future: dissemination of results, consciousness-raising and establishing the first botanic garden in the Camargue

The next set of goals include disseminating the results at the local, national and European levels, increasing public awareness and promoting the exchange of information with other sensitive natural sites which encourage eco-tourism and seek to engage in a similar eco-friendly process. At the same time, a partnership between the Gaz de France Foundation and the Conservatoire du Littoral will establish a botanic garden, the first in the Camargue.

FOR MORE INFORMATION

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2.1.1

GSM manufactures and markets aggregates. Aggregates are small pieces of stone measuring between 0.01 and 125 mm; they are the residue from quarrying and the processing of quarried stone, both friable and consolidated. Overall there are five main stages in the production process:

- Stripping away the unusable layers;
- Extracting the material;
- Transferring it to the processing site;
- Processing the aggregates into finished form;
- Reclaiming the extraction site.

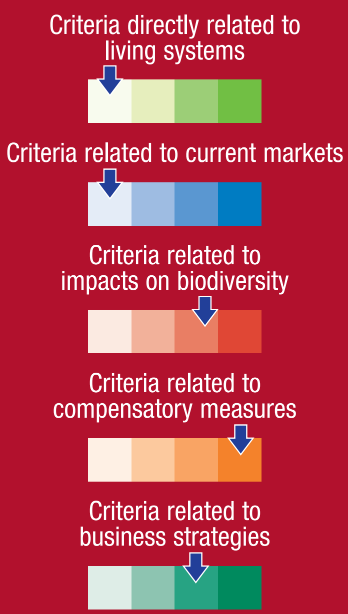
Between 1992 and 2006, GSM formulated an environmental policy on a national level, with 3 successive five-year plans, to be implemented on the ground for all its operations. A report was published at the close of each plan, in 1997, 2003 and 2007, describing the actions undertaken. With 15 years' experience to rely on, GSM is pursuing continuous improvement to the environment, working in three areas which form the basis of its activity:

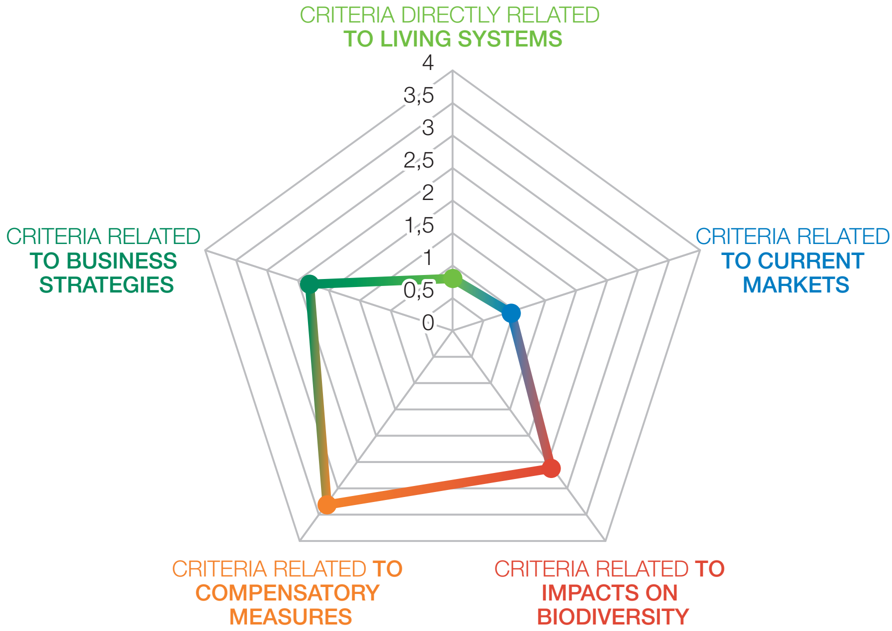
- The integration of its quarrying operations into the surrounding landscape;
- Resources and logistics;
- Managing environmental impacts.

GSM IN FIGURES

- The French subsidiary of the Group Italcementi
- **32** million tonnes of aggregates
- **800** employees
- **78** quarries in France and Belgium

SELF-ASSESSMENT





> *Sites rich in biodiversity are major assets for integrating rehabilitated quarries into the landscape.*

THE INTERDEPENDENCE OF GSM WITH BIODIVERSITY

SUMMARY OF THE INTERVIEW WITH *ORÉE* ABOUT THE BUSINESS AND BIODIVERSITY INTERDEPENDENCE INDICATOR

CRITERIA DIRECTLY RELATED TO LIVING SYSTEMS

Dependence on raw materials derived from living systems

GSM does not depend on living systems of the present day as a resource. The aggregates are derived from friable stone (sand, gravel, marine rock), limestone or igneous rock and by recycling construction by-products such as crushed concrete. Friable stone is mostly recent, from the Quaternary era, while hard stone belongs to more ancient geological formations, mostly minerals. However, biogenic limestone originates in the distant past, from the accumulation of bones and shells rich in $CaCO_3$, and

2.1.1

living systems of past eras have certainly played a role in its formation. Limestone accounts for about 25% of the annual production of aggregates. This material is of use to the company, but on the national level it would be misleading to speak of dependence on raw materials derived from living systems for the production of aggregates. However, **fossil resources** are essential for shipping the products sold as well as transporting other goods.

Some taxa, in this case birds, can coexist with the active extraction of aggregates by GSM

Dependence on services and technologies from living systems

GSM does not have any obvious dependence on **ecological services,** except in the sense that geological formations constitute a "free" source of materials, a form of ecosystem provisioning service. When maintaining production standards requires washing the aggregates, the operations depend on an adequate supply of water. However, water of good physical/chemical quality is not essential to this industrial process. Occasional disturbances of the soil ecology and its resulting services at sites of operations may affect regulatory and support services, albeit only locally. There is no connection with biomimetism and technological or organisational innovations. Environmental engineering work on the rehabilitation of quarries relates to **ecomimetism,** but these activities are only indirectly related to our industrial operations and are contracted out.

Management of the variability, health and complexity of ecosystems

Understanding the effects of biophysical **and chemical variation** on the quality of the aggregates requires a very long-term perspective which goes beyond the time-frame of our operations. Basically, **protecting ecosystems** can entail constraints. These may be seasonal, leading us to modify our operating methods to avoid nesting periods, or to stop the extraction of marine aggregates while fishing or harvesting shellfish is in process. GSM recognises **ecosystem complexity** as a key criterion for the performance of its operations, especially for managing impacts and choosing targets and indicators for the environmental rehabilitation of quarries. What indicators should be used to monitor the dynamics of biodiversity throughout the life cycle of a quarry?

Integration into the landscape is a major challenge for GSM: the GSM quarry at Maine de Boixe, certified ISO 14001

CRITERIA RELATED TO CURRENT MARKETS

Operating costs mainly concern the industrial processes of extraction and labour costs, and also the purchase of deposits from private landowners or the payment of royalties related to concessions covering marine aggregates. There are **no direct costs associated with living systems of past eras,** and the volume of product realised from them forms only a **small proportion of sales.** The costs associated with living systems of the present are indirect, and relate to the rehabilitation of the quarries and environmental engineering operations on the sites. As for the quarrying itself, the newly important issue of biodiversity does not arise in any way with respect to **market positioning.** That said, changing attitudes and expectations suggest that it will attract more attention in the future in the context of consultations with stakeholders about the design of operations, rehabilitation and reuse of the extraction sites.

CRITERIA RELATED TO IMPACTS ON BIODIVERSITY

The issue of impacts on living systems is a crucial one for the aggregate industry. Its operations require large areas of land and the effects on habitats can be substantial. The entire life cycle of a quarry is at issue - at the moment of site selection, during the operations and during rehabilitation. **Returning the ecosystem to its original state** is only sometimes possible, often by backfilling the quarry to restore the area to agricultural or forestry use. All quarry rehabilitation aims at restoring ecological functioning.

With respect to **changing the landscape,** the amount of alteration of its contours varies depending on the type of stone involved. Quarrying massive stone (sandstone, limestone, igneous rock) results in significant topographic modification, while in the case of friable stone (alluvial deposits, sand, chert, marine aggregate) only valleys and the seabed are modified, with results that are harder to observe. A quarry is often seen as a blot on the landscape. However, other practices, such as intensively farmed monocultures, also significantly alter habitats, without necessarily being perceived as undesirable. Involving stakeholders in the issue of the integration of quarries into the landscape is thus a pressing concern.

Otherwise, **very little pollution** is generated. The only hazardous materials are the hydrocarbons used to operate the machinery. The limited monitoring of wastewater is related to this parameter and to the Total Suspended Solids (TSS), Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD). Dust can also be a minor factor in physical pollution.

With respect to **impacts on species,** pressures are occasional and localised, but may pose problems when new sites are to be developed. The addition of perimeter protection zones limits the potential range of operations. Impact studies are conducted to take account more fully of local biodiversity: how to make the quarries compatible with the goals of preservation and management of habitats and species has to be determined, as in the case of impact assessments performed in Natura 2000 zones.

Finally, positive impacts on biodiversity need to be highlighted. Rehabilitated quarries can become the habitat for a variety of species. Although **fragmentation of the natural environment** results from the original excavations, the refurbished areas often form part of ecological continuities, such as the restoration of wetlands which then become important stopovers for migratory birds.

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CRITERIA RELATED TO COMPENSATORY MEASURES

Quarry operators are **legally required** to analyse the effects of their activities on the sites and surrounding landscapes, wildlife, natural habitats and ecological balance, and to propose measures to reduce or eliminate the impact and after-effects on the environment. The same regulations require the rehabilitation of disused quarries. This is **not viewed as a compensatory measure in the strict sense:** the ultimate goal is to ensure that a site is integrated into its environment while it is in operation. The law of 1970 and its accompanying decree of 1971 require the rehabilitation of disused quarries. In 1977, a decree required quarry operators to submit environmental impact studies. In 1993, quarries in France were removed from the mining classification and reassigned to that of Classified Installations. New measures were introduced, including financial guarantees of rehabilitation. Through ecological restoration, quarries contribute to biodiversity. Cases of **compensation performed elsewhere** can be adduced for Natura 2000 zones and quarries in wooded environments (undergrowth clearing), taking the form of reforestation, subcontracted or otherwise, at some other location. Recently, GSM and the IUCN have signed a three-year agreement incorporating a joint commitment and skills exchange to implement a biodiversity policy for the company. This will include strategies and action plans, and is to be monitored.

CRITERIA RELATED TO BUSINESS STRATEGIES

Several considerations lead GSM to assess its interdependence with biodiversity. The first relates to **community, especially local, pressure,** which can be very forceful in the case of the aggregate extraction sector. **To sustain operations over the long term,** emphasis is laid on the integration of quarries into the landscape, for reasons that are psychological as well as conservationist. In this connection, rational management of the quarried areas and their eventual rehabilitation are coming to be advantageous with respect to **competitiveness.** Environmental restoration is becoming an essential prerequisite for gaining **access to new sites,** and public relations efforts on issues of biodiversity have thus begun to be important. Employees are often personally attached to the natural heritage sites where they work: heritage species and the improvement of the landscape are **collective concerns** which should be developed further.

The steps taken by GSM to promote biodiversity

Since 1993, quarries have been subject to the law on Classified Installations for the Protection of the Environment. GSM goes a step further than the stipulations embodied in the law by adopting a proactive attitude to the closing down of its exhausted sites. Rehabilitating the quarries can make it possible to redesign the sites for socially beneficial purposes. Goals are fixed on a case-by-case basis in consultation with stakeholders.

To restore a quarry at the end of its useful life by reintroducing its ecological function promotes local biodiversity and ensures the continuance of the quarrying industry by fulfilling the expectations of its stakeholders. The growing interest in the ecological heritage preserved in rehabilitated quarries is an incentive for GSM to think of ways to maintain a diversity of environments. Much work has been done in this direction, combining environmental diagnosis, scientific and technical partnerships, monitoring of some habitats and maintenance of sites.

THE CASE OF THE QUARRY AT CAYEUX-SUR-MER (80)

In operation since 1980, covering an area of 96 hectares, the quarry at Cayeux-sur-Mer was excavated to extract friable stone and silicate pebbles of marine origin. In 1991, GSM initiated a rehabilitation project based on a group of research studies, in consultation with local authorities. The significant ecological potential of the site, located on the edge of the Baie de Somme, was emphasised, and its purpose was rethought accordingly. Today, rehabilitation takes the form of a bird sanctuary made up of shoals, islets, peninsulas and winding shoreline. Gravel bars were laid down to encourage plovers to nest. Ponds were also dug to house amphibians.

Beyond the redevelopment of the site, the company has embarked on several major operations in the area, in particular the rebuilding of an eroded dune with an average height of three metres, over a kilometre in length. In 2003 and 2005, GSM pursued the experimental transplanting of lichens with a view to conserving these unique species, an experiment applauded by the scientific community.

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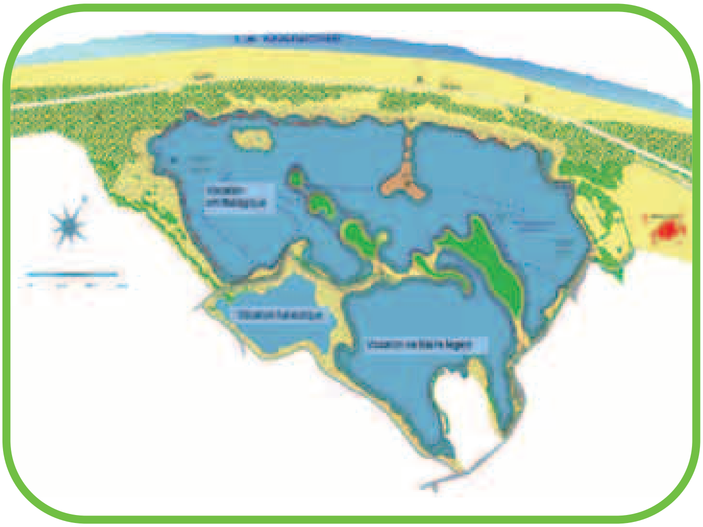
The role of the quarry at Cayeux-sur-Mer in sustainable development in the Baie de Somme
The Baie de Somme enjoys almost all the legal safeguards in force for coastline areas. The rehabilitation of the landscape and ecology of the quarry is integrated into the development plan for the bay, and into the plan for gaining listed status for the Pointe du Hourdel. The redevelopment of the site is taking place along with discussions of the economic possibilities of converting the use of the bay from gravel extraction to eco-tourism, in conjunction with the Parc du Marquenterre and the Maison de l'Oiseau. In 2005 the Union Nationale des Producteurs de Granulats (UNPG) awarded its prize for sustainable development, in the category of "community partnerships", to the Cayeux-sur-Mer quarry.



Landscape and ecology rehabilitation at the disused Hourdel quarry
Commune de Cayeux-sur-Mer

PARTNERING WITH THE IUCN TO DEVELOP A BIODIVERSITY POLICY

GSM and the French Committee of the International Union for Conservation of Nature (IUCN) recently signed a partnership agreement. Over a period of three years, it aims to define and implement a biodiversity policy which forms part of GSM's Environmental Management System.

The partnership focuses on 4 areas:
- Support for the integration of biodiversity into company policies;
- Advice and expertise;
- Skills exchange and planning for the future;
- Initiatives and projects.

Its goals are:
- To assess the state of existing knowledge within GSM and more broadly on issues relating to quarrying and biodiversity (on a national and international level);
- To identify the specific needs of the company, prior to developing effective action plans, relevant indicators and training programmes responsive to these various needs.

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INERIS

*maîtriser le risque
pour un développement durable*

Founded in 1990, INERIS - the Institut National de l'EnviRonnement industriel et rISques - is an Établissement Public à caractère Industriel et Commercial (EPIC - Industrial/Commercial Public Corporation) under the supervision of the Ministère de l'Ecologie, de l'Energie, du Développement Durable et de l'Aménagement du Territoire (MEEDDAT - Ministry of Ecology, Energy, Sustainable Development and Land Management).

Its primary mission is to conduct or supervise research aimed at preventing the risks which economic activities pose to the security of individuals and property, health and the environment. Its expertise is offered to governments, businesses and local authorities.

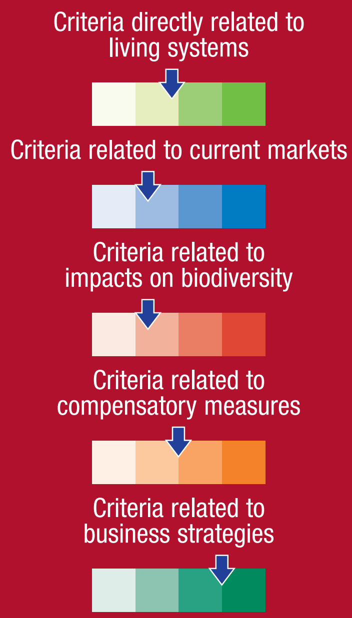
INERIS combines experimentation, modeling and methodology in the study of risk and also makes use of feedback. Its laboratories perform physico-chemical analyses and its testing facilities are among the most extensive nationally. It has a support group ready to handle emergencies, which can go into action in the event of a major industrial accident.

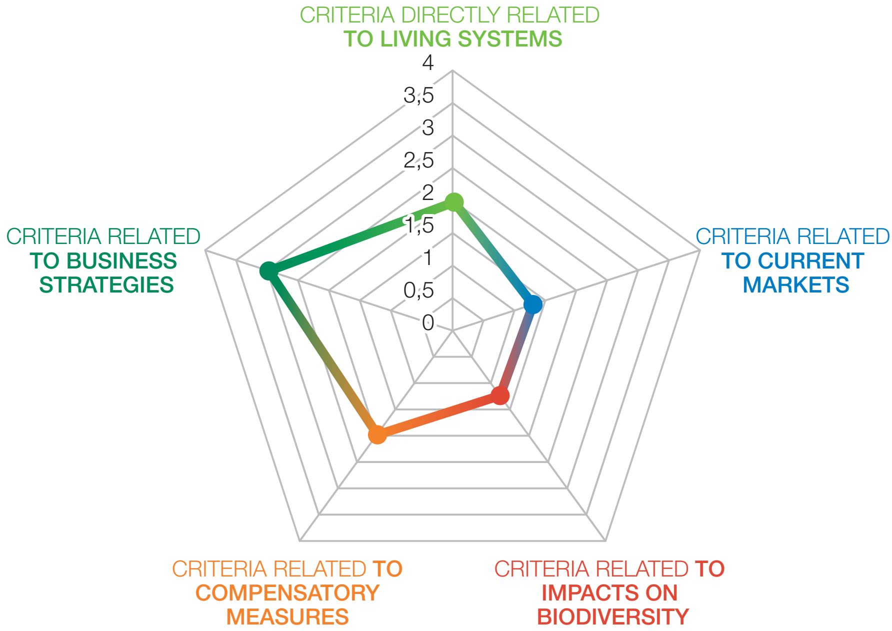
The work begun quite some time ago on the subject of biomarkers demonstrates the importance of the research undertaken by INERIS on the natural world and ecosystems and on the risks associated with them.

INERIS IN FIGURES

- Total budget of **58M €** of which **21%** is allocated to research
- **563** staff including **320** engineers, scientists and managers
- **5** divisions: Chronic Risks, Accident Risks, Ground and Subterranean Risks, Certification, Advances and Marketing

SELF-ASSESSMENT





> *By providing appropriate tools and methods, INERIS can influence the choices made by businesses and local governments in their interactions with biodiversity.*

THE INTERDEPENDENCE OF INERIS WITH BIODIVERSITY

SUMMARY OF THE INTERVIEW WITH *ORÉE* ABOUT THE BUSINESS AND BIODIVERSITY INTERDEPENDENCE INDICATOR

CRITERIA DIRECTLY RELATED TO LIVING SYSTEMS

Dependence on raw materials derived from living systems

Given that its primary mission is research and expertise sharing about the risks connected with business operations, INERIS is by definition **not directly dependent on living systems.** Relative to its production methods and its size and importance, its dependence on living systems is limited. It is rather with respect to production of knowledge that the institute is linked to biodiversity, in that it provides the industrial sector with the tools for reducing their environmental impacts. The organisation's direct

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dependence on **fossil resources** is limited to the fuel needed for its employees' travel in France and abroad.

Dependence on services and technologies from living systems

The concept of **ecological services** is not of great importance for the operations of INERIS. However, through its involvement in ecosystem risk areas, such as hazardous waste, industrial wastewater and contaminated soil, it can provide information, techniques and methods to businesses to help them keep these ecological services functioning. One example is the disposal of sludge from wastewater treatment plants. By determining the levels of toxicity and that of compost spread on farmland, the Institute can instigate a change in regulations, with the goal of encouraging businesses to make use of ecological services more effectively (retention of organic matter in the soil, natural water purification methods). Some research teams, such as those investigating toxicological and eco-toxicological risks, use **biotechnologies** such as cell cultures derived from genetically manipulated cell lines.

Management of the variability, health and complexity of ecosystems

The **variability of the bio-physico-chemical components of ecosystems** does not directly concern the organisation. However, seasonal variation can affect fieldwork and the behaviour of organisms dependent on specific temperature ranges. Our experts and scientists are aware of issues related to climate disturbances, but few research projects have been planned in this area. In contrast, the **health of ecosystems** is a key subject: the management of industrial waste and soil pollution affects the operations of many businesses, sometimes creating significant environmental liabilities. INERIS can help these companies initiate appropriate measures.

Collecting fish samples in man-made rivers or mesocosms

Laboratory research makes use of simplified biological processes in order to circumvent the **complexity of natural ecosystems.** This is a necessary step if artefacts are to be avoided. By creating mesocosms, for instance, meaning simplified aquatic environments, the effect of a pollutant on an individual or population can be tested outside its actual environment. Such an approach, despite its scientific rigour, can be of only limited application in real situations: the dynamics of natural ecosystems present a multiplicity of interactions which are difficult to predict in environments undergoing change.

CRITERIA RELATED TO CURRENT MARKETS

The **cost of raw materials from living** systems is trivial compared to staffing costs, and is limited to the purchase of specimens for laboratory work. The various departments do not all have the same relationship to living systems and are not dependent on them in the same way. Although living systems are strategically important for the Institute, the **volume of income** from services associated with them is still relatively small. The "Risks" division focuses on impacts on human health. A new division, "Hazards and impacts on living systems", will offer services associated with the determination of impacts related to biodiversity at all levels, from the gene to the ecosystem, using an essentially ecotoxicological approach.

CRITERIA RELATED TO IMPACTS ON BIODIVERSITY

The core of the organisation's work is the furnishing of information and methods for **reducing the impacts of industrial operations on the environment,** covering chemical materials and products, technological and pollution risks, risks related to disused mines, underground storage facilities and natural hazards. The resulting effect on ecosystems is a positive one. However, the direct impact of INERIS on biodiversity is hard to quantify. Some of its buildings are responsible for **landscape modifications,** and in consequence a decision has been made to adopt High Environmental Quality (HQE Label) standards in new construction. The Institute has also begun discussions of its own environmental responsibilities, primarily with respect to the greenhouse gas **emissions** generated by staff travel. Two electric vehicles are available for employees' use, and daily shuttle buses take employees to and from the nearest railway station. Although scientific experiments are performed on laboratory animals, this does not affect in any way the **survival of the species** in its own environment and does not result in **fragmentation of its habitat.** The choice of the stickleback, a common species in French rivers, for work on biomarkers is a good illustration of this. At the same time, research performed for government departments leads to new legislation intended to prevent environmental risks and protect ecosystems.

CRITERIA RELATED TO COMPENSATORY MEASURES

Compensation for impacts does not directly concern the organisation, but does concern its industrial clients who are subject to ICPE regulation. INERIS **helps businesses to comply with the regulations** and choose relevant indicators for managing their impacts. The "Hazards and impacts on living systems" division is responsible for issues which directly affect risks to the biodiversity and health of ecosystems.

CRITERIA RELATED TO BUSINESS STRATEGIES

Historically focused on risks to human health (it was formerly known as Charbonnages de France), INERIS has expanded its strategies to **research** and **expertise** on the **management of environmental risks.** Some of its teams have been made conscious of biodiversity issues by the nature of their work, and they help enrich the **organisation's corporate culture.** In addition, INERIS has initiated a plan to connect more extensively with **non-profit organisations.** The Institute intends to disseminate the results of its work more widely and also to include questions affecting civil society to a greater degree in defining its areas of research. With respect to **competitiveness,** or rather the **relevance of the services** it offers, the Institute seeks to increase its credibility both in France and abroad; hence the importance of **effective public relations,** both at the scientific level and at that of the stakeholders

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in the discussions in question. The risks to the health of ecosystems represent an opportunity to enhance and expand the organisation's expertise and to develop research, techniques and **innovations** into an ecosystem-wide vision of risk management, a process that is still in its infancy for most organisations and businesses. The study of biomarkers is a first step in this direction.

The steps taken by INERIS to promote biodiversity

A MULTIPLE BIOMARKER APPROACH TO MONITORING AQUATIC ENVIRONMENTS: FROM RESEARCH TO ACTION

Since 1999 the Institute has been conducting research into the development, validation and employment of biomarkers in fish. Biomarkers are defined as observable or measurable changes at different levels of biological organisation which indicate that an organism has been exposed to at least one pollutant. Using these biological tools, the initial effects of contamination on organisms can be gauged, taking into account the bio-availability of the contaminants, how they are metabolised and how their molecules interact. These tools complement the chemical and ecological methods traditionally adopted to monitor aquatic environments. The work done by INERIS is in three stages: the development of sensitive and robust methods for bioassay of the biomarkers; identifying the response of the biomarkers under controlled conditions; and the validation of the tools *in vivo.*

The laboratory: an essential stage

Prior to any research or application of biomarkers in vivo there is a necessary first stage in which bioassay methods are developed and optimised and the biomarkers are tested under controlled conditions. Initially several assays of biomarkers traditionally used in eco-toxicology are optimised for different European river species. The relevant biomarkers include biotransformation enzymes, markers of oxidative stress and a neurotoxicity marker.

To measure the exposure of organisms to endocrine-disrupting pollutants, enzyme-linked immunosorbent assay methods have been developed for the assay of vitellogenin, a biomarker of oestroge-

Three-spined stickleback (Gasterosteus aculeatus) nicity in male fish. This is also performed to identify the presence of spiggin, a specific marker of androgenicity in female sticklebacks. Following the methodological developments, the response of the biomarkers is identified under controlled conditions, using reference substances and/or environmental contaminants. The specificity, sensitivity, inductibility and reversibility of each parameter can thus be determined. The data obtained make it possible to position the species studied in relation to one another on the basis of the inductibility or sensitivity of the responses.

***Validation* in vivo**

Identification of biomarkers is also carried out in situ, in different contaminated areas, to take account of the complexity of the environment and its contamination in evaluating the potential of biomarkers for monitoring waterways. Firstly, this makes it possible to assess the effect of biotic and abiotic environmental factors on the baseline levels and on the response of the biomarkers under investigation. Practical rules for the use of biomarkers are thus defined, to determine where possible the physiological values of the different markers under investigation. Secondly, this research seeks to assess the biomarkers in comparison to other methods of monitoring the quality of aquatic environments. The research performed at INERIS, in collaboration with the Office National de l'Eau et des Milieux Aquatiques (ONEMA), has highlighted the potential of biomarkers to differentiate the fieldwork sites and to identify the earliest effects of contamination on fish, thus positioning the multiple biomarker approach as a method which complements the conventional chemical and environmental methods.

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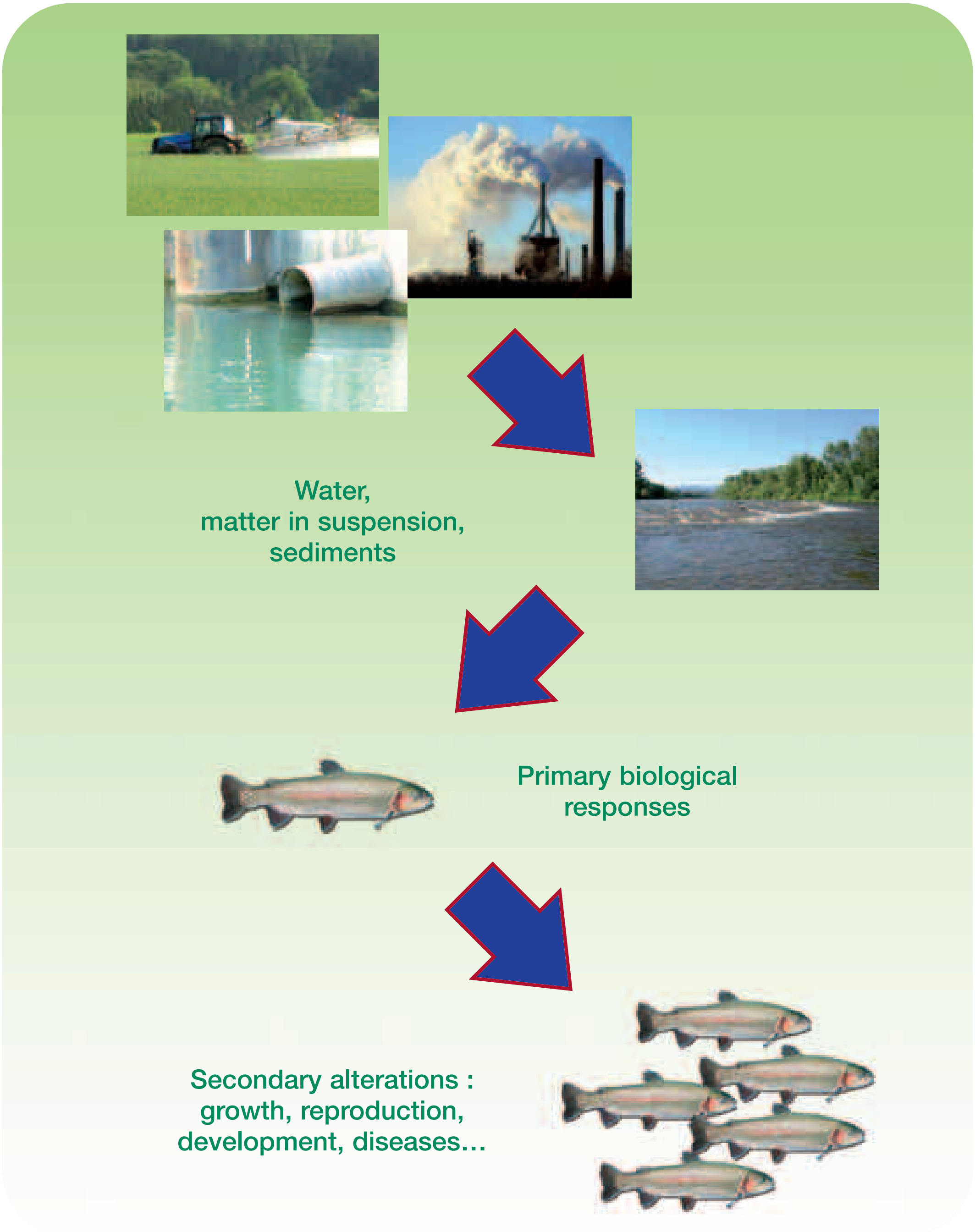

From environmental contamination to biosurveillance of aquatic environments

In order to synthesise and disseminate the research results, an eco-toxicological index based on the response of the biomarkers has been developed and validated. As in the case of the biomarkers, this index enables the differentiation of sites based on the biomarker response and provides complementary information to that furnished by the other indices traditionally used for the management of aquatic environments: conventional indices are based on the chemical contamination of the environments or the disruption of communities of species. Its applicability to permanent surveillance networks for aquatic environments, as defined by the European Water Framework Directive, is now being assessed through a project funded by the Artois Picardie water department.

FOR MORE INFORMATION

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LVMH
MOËT HENNESSY . LOUIS VUITTON

LVMH is one of the top five global players in the luxury business. Since its founding in 1987 it has continuously achieved high growth on an international scale. The group has a longstanding commitment to the environment, strengthened in 2001 when its President, Bernard Arnault, signed the LVMH Environment Charter, in 2003 when the group joined the World Pact, and in 2007 with the ratification of Gordon Brown's Millennium Development Goals.

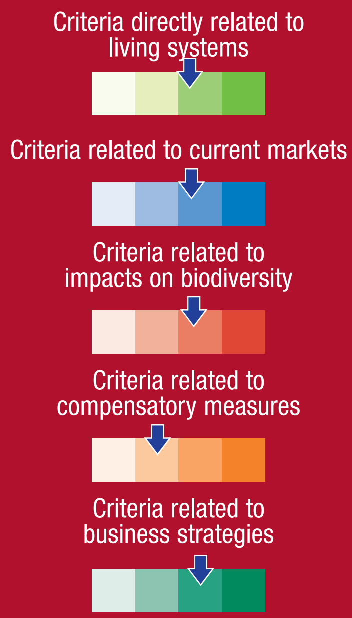
The LVMH group's companies represent the realm of skilled craftsmanship at its most refined and successful. They pay meticulous attention to the quality of their products, which embody a tradition of unsurpassed excellence. The resources used in the manufacture of their products come primarily from the natural world and are intimately bound up with it; they are always treated with care to protect their sources. A plan for management of the environment has been put in place in all the group's member companies, and employees, trained to address these issues, are highly motivated. Significant progress has been made in optimising the use of natural resources by reducing waste as well as water and energy consumption.

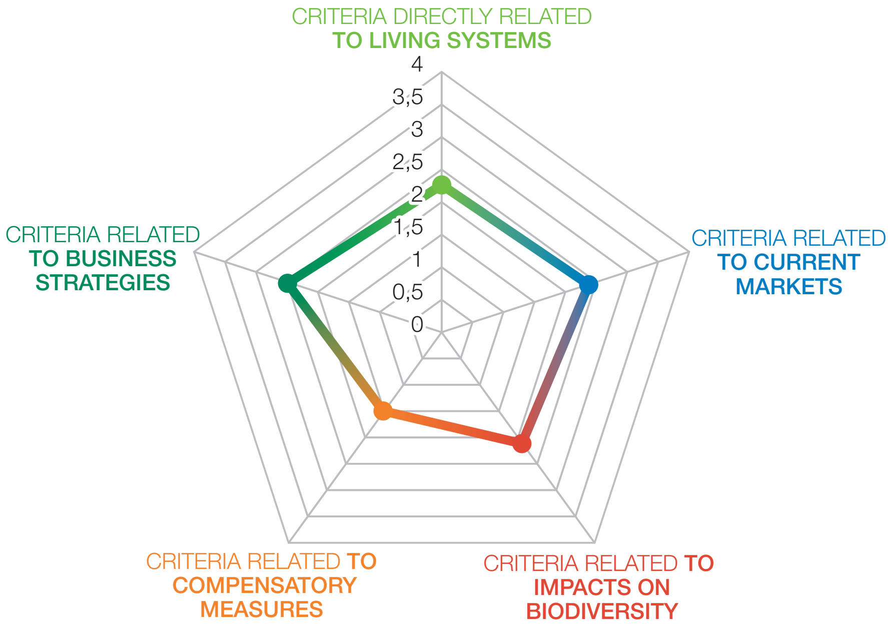
The Environmental Affairs Department assists the group's members to meet the requirements of its Charter and to improve year-on-year performance. Substantial investments have been made to achieve these goals, bringing together a variety of components: environmental management, energy consumption, atmospheric emissions, construction in tune with the environment, underwater emissions, consumption of water, environmental risk management, waste recycling and biodiversity.

LVMH IN FIGURES

- 2007 sales of over **16 billion** €
- **5** sectors:
  - **Wines and Liquors**
  - **Fashion and Leather Goods**
  - **Perfume and Cosmetics**
  - **Watches and Jewellery**
  - **Selective Retailing**
- • A portfolio of world-famous brands, including:
  Louis Vuitton - Moët & Chandon - Château d'Yquem - Parfums Christian Dior - Hennessy - Sephora - Kenzo - Guerlain - Givenchy - Céline - Tag Heuer - Emilio Pucci - Chaumet - Fendi

SELF-ASSESSMENT





> *"LVMH seeks a balance between the manufacture of luxury products and the conservation of the resources from which they are made."*

THE INTERDEPENDENCE OF LVMH WITH BIODIVERSITY

SUMMARY OF THE INTERVIEW WITH *ORÉE* ABOUT THE BUSINESS AND BIODIVERSITY INTERDEPENDENCE INDICATOR

CRITERIA DIRECTLY RELATED TO LIVING SYSTEMS

Dependence on raw materials derived from living systems

LVMH operations are divided among three principal sectors, all of which use **large quantities of resources from living systems,** to varying degrees. The Wines and Liquors sector depends on viticulture, while Perfumes and Cosmetics requires large quantities of plants. The textiles and leather needed for the Fashion and Leather Goods division are derived from living species. Some stores in our Selective Retailing sector, such as the Bon Marché, include a food hall. Petroleum and its derivatives, derived from

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living systems of past eras, are essential to shipping products around the world, transporting staff and packaging goods.

Dependence on services and technologies from living systems

The group depends on **provisioning ecological services,** including water to irrigate its vineyards around the world and plant biomass for perfumes and cosmetics. Viticulture and the harvesting of plants for their active ingredients, as well as the food sector, depend on **regulatory and supporting ecological services,** including primary production, the provision of habitats, nutrient recycling, soil conservation and formation, climate regulation, the water cycle, combating invasive species and pollination. Methods for combating vineyard pests, such as pheromones which induce sexual confusion, are associated with **biomimetism.** The use of yeast in fermentation processes is a good example of the use of biotechnologies.

Management of the variability, health and complexity of ecosystems

Bio-physico-chemical parameters beyond our control seriously affect production processes and are often viewed as constraints. At the moment, production follows a linear model, and only slight variation from the standards is permitted, with a premium placed on uniformity of product. **Ecosystem health** is essential for the supply of many raw materials derived from living systems: some plants used in cosmetics grow only in their original habitat, under special conditions, and do not tolerate the degradation of the habitat. LVMH seeks to draw upon the **complexity of ecosystems,** making use of a wealth of products relying on the complexity of active ingredients which cannot be reproduced artificially, as well as biomimetism and pest management in viticulture.

Grape harvest at the Krug vineyard of Clos du Mesnil

CRITERIA RELATED TO IMPACTS ON BIODIVERSITY

The **cost of raw materials derived from biodiversity** is low compared to the cost to manufacture the products, and of labour and marketing. In the case of cosmetics, for each euro spent on raw materials, ten Euros are spent on transport and a hundred on **publicity** and **marketing.** LVMH sells **luxury products** often associated with high-value or rare resources from biodiversity. **More than half of its sales** are generated by products derived from living systems: wines, spirits, perfumes and cosmetics based on natural ingredients, leather or silk clothing and foodstuffs.

CRITERIA RELATED TO IMPACTS ON BIODIVERSITY

The group's physical sites are sources of individual, **irreversible impacts** on the natural environment. Vineyards cover large areas and are in effect **artificial zones,** hence potential sources of **ecological discontinuity.** However, efforts are being made **to integrate the sites into the landscape,** as demonstrated by the new cosmetics R&D building, constructed to HQE standards. The extraction and processing of raw materials for the Watches and Jewellery sector (precious stones and metals) are additional causes of **landscape alteration** and environment destruction, but these fall under the responsibility of the suppliers. Pollution results mainly from pesticides in the agricultural sector and the effluent from distillation and vinification residues, high in organic matter, in the wine sector. Greenhouse gas emissions in transport operations are also significant. Moreover, the lack of knowledge of the toxicity of some materials sometimes makes it difficult to assess impacts: the group has now adopted a proactive approach and is beginning to research the eco-toxicity of each component of its products. The issue of waste is also addressed, as is the use of recycled materials in packaging the products. Lastly, monocultures (wine) and livestock (leather goods) can be sources of **selective pressure on the distribution of certain species.** While the amounts extracted are not large in terms of tonnage in the Perfumes and Cosmetics sector, there is still a need to introduce sustainable management practices for species concerned, such as edelweiss cultivation in Switzerland.

CRITERIA RELATED TO COMPENSATORY MEASURES

LVMH operations are not affected by **regulatory compensation measures.** Some compensation measures assessed on a case-by-case basis highlight the group's willingness **to go beyond what the regulations require.** Reforestation of tree species overseas is one example. Although there is thus far no specific **sponsorship** in the domain of the environment, the Perfumes and Cosmetics division is engaged in sustainable partnerships with local communities. In Burkina Faso, in addition to the economic benefits for the villages concerned, a project for collecting the bark of *Anogeissus leiocarpus* has led to the creation of a botanical garden for educational purposes.

CRITERIA RELATED TO BUSINESS STRATEGIES

Addressing biodiversity is a new challenge for LVMH, and **social pressures** in this sphere are still minimal as regards its activities. However, resources derived from living systems affect the manufacture of a considerable number of the group's products. The diversity of living systems is also a **source of innovation** for the Perfumes and Cosmetics division. It is essential to its **competitiveness** in a market continually in search of new fragrances. **Public relations efforts with regard to environmental performance** are gradually coming to include considera-

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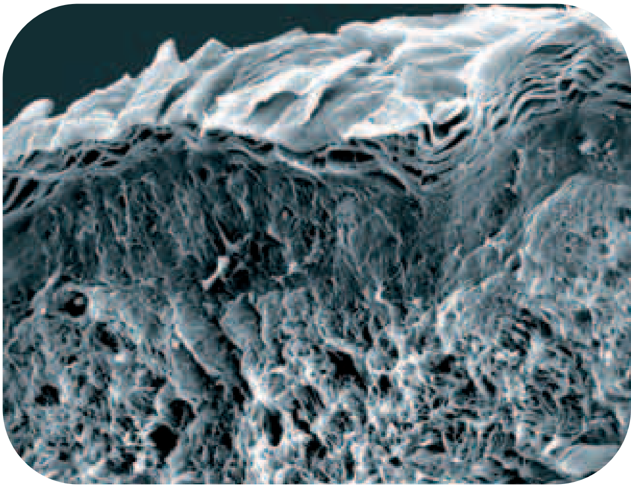
tions of biodiversity. Some products are certified as organically grown, but inertia in the current production system leaves little margin for **new business opportunities.** Within the group, "Sustainable Development Week" actively involves the employees, indicating the beginnings of a **shared pro-environment corporate culture.** For the future, in-house discussions on the subject of biodiversity are to be organised.



Skin is a complex ecosystem

The steps taken by LVMH to promote biodiversity

MANAGING ITS OWN IMPACTS VIA AN ENVIRONMENTAL MANAGEMENT SYSTEM

Answering directly to the CEO, the Environmental Affairs Department is in charge of LVMH's voluntary environmental policies. It oversees the implementation of the Environment Charter, collaborates with non-profit organisations, determines the overall direction of activity and assists the member companies of the group to implement their own initiatives. The Environment Charter requires each member to introduce effective environmental management and each of the CEOs to become involved. It is structured around five commitments:

- Advancing to a high level of environmental performance;
- Stimulating company-wide involvement;
- Managing environmental hazards;
- Ensuring a future for the company's products;
- Making a commitment that goes beyond the company's own activities.

Each member defines its management system based on the Charter and implements it while remaining in close contact with the Environmental Affairs Department. As is true of any human activity, LVMH's operations impact the environment in ways that vary in type and degree. The following table spells out the major environmental issues for each sector, managed either by the group itself or by its suppliers.

WINES AND LIQUORS

- Consumption of water (particularly for irrigating vineyards in Australia, New Zealand, Argentina and California) and energy (distillation processes)
- Production of effluents high in organic matter (vinification and distillation processes)
- Production of waste (vinification and distillation processes)
- Protection of the soil and of biodiversity (vineyard management and ecosystem protection)
- Consumption of raw materials, especially for packaging

PERFUMES AND COSMETICS

- Consumption of water
- Production of effluents high in organic matter
- Production and processing of raw materials (packaging and ingredients of perfumes and cosmetics)
- Protection of biodiversity (protection of renewable resources, including plants, necessary for production and related ecosystems)

WATCHES AND JEWELLERY

- Extraction and processing of raw materials (packaging, precious stones and metals)

MODE ET MAROQUINERIE

- Production and processing of raw materials (packaging, cotton and other textiles, leather, etc.)
- Protection of biodiversity (protection of renewable resources necessary for production and related ecosystems)

SELECTIVE RETAILING

- Consumption of water and energy (lighting, air-conditioning, cleaning)
- Shipping of products

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LVMH'S INVOLVEMENT IN BIODIVERSITY ISSUES

The preservation of biodiversity is a major issue for the Perfumes and Cosmetics and Wines and Liquors divisions. It constitutes a heritage that is indispensable for the smooth running of operations. Various measures are being implemented to encourage intelligently managed supply systems, techniques for reducing the impacts of operations and voluntarily undertaken rehabilitation projects.

Encouraging concerned discussion of sources of supply

LVMH respects the concerns of local populations with regard to crop cultivation. The group is forbidden to use rare plants whose preservation may be threatened or to engage in risky practices, such as collecting birch bark for making salicylic acid, which can destroy the trees.

Ethnobotany: local practical knowledge and the preservation of biodiversity are in harmony

To persuade its suppliers to adopt the same ethics, the group works in partnership with the Institute for Sustainable Development and International Relations in Madagascar. In Burkina Faso and Vietnam it organises mini-symposia to educate local people in best practices and the value of ethnobotany. Through these projects it participates in local economic development and actively contributes to the preservation of some plant species.

Improving intelligent viticulture and biodiversity protection

Both Moët & Chandon and Veuve Clicquot are adopting intelligent viticulture. Reducing the use of herbicides and encouraging alternative solutions to the use of some insecticides are among the group's high-priority goals. Planting grass cover in the vineyards also helps to balance the soil composition, create natural filters and reduce the growth of weeds. Veuve Clicquot is working on managing phytosanitary effluent by introducing new methods for storage and control and training staff in best practices. Moët & Chandon has reduced its use of herbicides by 8% through precision weed removal techniques, using tractors equipped with infrared cameras which can pinpoint the areas for application of the herbicides. Vineyards outside Europe - Cape Mentelle and Domaine Chandon Australia - are also making efforts in this direction by promoting organic growing methods.

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2.1.1

Founded by Francois Lemarchand in 1990, Nature & Découvertes is a French retail chain with a focus on nature. Its mission is to offer its customers a varied range of products closely linked to the natural world: organic gardening, hiking equipment, toys, eco-friendly products for the home, jewelry, books and musical instruments. Its shops, located all over France, are a gateway to nature

Respect for the environment is a priority across the board for Nature & Découvertes. From the construction of retail sites to the design and delivery of products to rubbish disposal and the calculation of the company's carbon footprint, minimising the environmental impact is an ongoing feature of all its operations. Nature & Découvertes is also the first retail business to have obtained ISO 14001 certification for all its sites, including its shops, warehouses and company headquarters.

For the last 14 years, the company has returned 10% of its annual net profits to the Fondation Nature & Découvertes, in accordance with the commitment to the environment enshrined in its charter. Thus far nearly 800 projects have been funded for a total of more than 5 million euros, mainly to support non-profit organisations which aim to protect biodiversity and educate the public about the natural world.

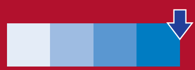
NATURE & DÉCOUVERTES IN FIGURES

- 2006 sales of **154M** €
- **63** retail outlets in France with nearly **970 staff**
- **5,8** million customers in 2006
- Over the last **14 years,** nearly **800 projects** funded by the Fondation Nature & Découvertes for a total of **5M** €

SELF-ASSESSMENT

Criteria directly related to living systems

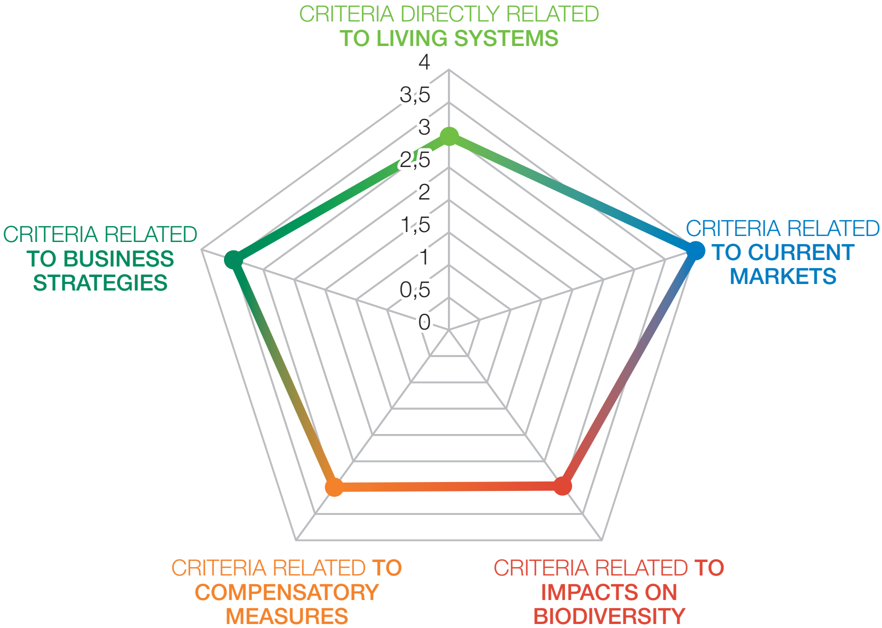
Criteria related to current markets



Criteria related to impacts on biodiversity

Criteria related to compensatory measures

Criteria related to business strategies



> *“Nature & Découvertes is a company with a commitment, offering its customers products and services closely linked to the natural world.”*

THE INTERDEPENDENCE OF NATURE & DÉCOUVERTES WITH BIODIVERSITY

SUMMARY OF THE INTERVIEW WITH *ORÉE* ABOUT THE BUSINESS AND BIODIVERSITY INTERDEPENDENCE INDICATOR

CRITERIA DIRECTLY RELATED TO LIVING SYSTEMS

Dependence on raw materials derived from living systems

The range of products offered by Nature & Découvertes is closely linked to the natural world. A large proportion of the articles sold are **manufactured from biomass** - books, wooden items, oils and textiles. With around 60 shops in France, the group is also dependent on **fossil fuels** for transporting its employees and importing its products (38% of them come from China).

2.1.1

Many products originate in the natural world

Dependence on services and technologies from living systems

The dependence of Nature & Découvertes on ecological services affects all our employees, beginning with the air they breathe and the water they use each day. This relationship is also manifest at the supply level: suppliers rely on raw materials from living systems **(provisioning services)** and on the **support and regulatory services** which underpin their operations. The company is a close observer of the natural world. Its product line is designed to highlight the cultural services we receive from nature. Although **biomimetism** is not systematically developed, it informs our thinking about the eco-design of future products and shops. For example, the raindrop-shedding glass in our shop windows uses a technology adapted from the properties of hydrophobic lotus leaves.

Management of the variability, health and complexity of ecosystems

These criteria relate to the suppliers of Nature & Découvertes. **Variability in ecosystems** can affect the price and availability of the raw materials purchased. The **health of the ecosystems,** including forested and farmed regions, is important for the reliable supply of materials. For instance, a massage lotion manufactured from honey owes its very existence to pollinating insects, which are highly sensitive to pesticides. Broadly speaking, the degradation of soil, water or air generates extra costs, whether for measures to reduce pollution or for additional inputs. The company offers several products manufactured from species which grow in unique environments, such as guarana and acerola. These plants **interact in complex ways** with other organisms and depend on very specific environmental conditions which it is difficult or very expensive to reproduce artificially.

CRITERIA RELATED TO CURRENT MARKETS

Between 50% and 60% of the **products marketed** by Nature & Découvertes are natural in origin, that is, derived from living systems. Apart from mineral-based extracts, nearly the whole of its product line has a connection with biodiversity, with **varying costs** depending on the materials and their source. Wood certified as sustainably grown and organically farmed foodstuffs typify the company's **market positioning:** to encourage its customers to develop closer ties with nature.

CRITERIA RELATED TO IMPACTS ON BIODIVERSITY

Shops sited in commercial urban areas have a relatively large footprint. Nature & Découvertes has consequently chosen to make use of alternative materials such as wood and glass so as **to fit more seamlessly into its surroundings** and narrow the gap between urban and rural or wild areas. Concrete steps have been taken in pursuit of ISO 14001 certification, in particular monitoring greenhouse gas emissions. Maritime transport of goods is a major source of **pollution** worldwide: giant container ships equipped with sails are now preferred to conventional vessels.

Alteration of the landscape, fragmentation of environments and **selective pressure on species** do not directly affect the company's physical assets. They do concern its suppliers of oils and timber, mainly through deforestation of tropical forests: these impacts are very real and sometimes substantial. Even though the company is aware that most of the farming on which it relies promotes habitat fragmentation, its share of responsibility remains limited: we can draw attention to its efforts to diversify its sources of supply in accordance with the particular environmental issues affecting each species and the places where they are grown.

CRITERIA RELATED TO COMPENSATORY MEASURES

No **compensatory measures** have been taken in the construction of the buildings owned by Nature & Découvertes, except for some specific instances of soil reclamation for battery storage facilities, in compliance with the regulations governing Installations Classées pour la Protection de l'Environnement (ICPE - Classified Facilities for the Protection of the Environment). Some environmental initiatives could be seen as a form of **voluntary compensation** for ecosystems, such as the reduction of greenhouse gases, eco-friendly product design and diversification of supply routes. The projects supported by the Fondation Nature & Découvertes represent another form of voluntary commitment to biodiversity, in the form of **sponsorship:** 10% of the company's net profits are allocated to consciousness-raising and environmental conservation programmes.

CRITERIA RELATED TO BUSINESS STRATEGIES

The "Nature & Découvertes" brand has long been familiar to nature-lovers. Although **social pressures** as such are minimal, its **customers** are demanding: they want to be sure that the company is honouring its commitments. The company's initiatives with respect to environmental issues genuinely contribute to its commercial success and sustain its **competitive advantage.** From a product's initial sourcing to the end of its life, each stage of the production chain is thoroughly analyzed to ensure that Nature & Discoveries as a company respects the diversity of living systems. However, it is often difficult to reconcile **business strategies** and **ecological coherence.** A species of ladybird was marketed for some time as an organic alternative to the treatment of aphids with pesticides. It was not native to France but introduced from China, and there was some risk that it would compete with other local species. The company has therefore made the decision not to sell it. Likewise, Nature & Découvertes is in the process of acquiring Forest Stewardship Council (FSC) certification for its wood products, and has made a point of raising questions about the appropriateness of certain operations which are given certification after virgin forests have been deforested in order to cultivate exotic species such as eucalyptus. Only a minority of employees is truly aware of biodiversity issues.

2.1.1

The company invests considerable time and resources to increasing their **awareness** through showing documentaries and publishing reports and educational materials about its environmental responsibility. We need to work together to change our practices: there is no shortage of ideas for **new products** featuring eco-friendly design and **new sources of supply.** The Fondation Nature & Découvertes, the highlight of our public image when it comes to environmental issues, enjoys a very good reputation in the non-profit world, demonstrating that the company's active involvement is both substantial and genuine.

The steps taken by Nature & Découvertes to promote biodiversity

As an enterprise Nature & Découvertes is deeply committed to biodiversity. While it actively discusses the sourcing and daily management of its branches, in this area it is through sponsorship that the company invests its resources. The Fondation Nature & Découvertes funds a very wide range of initiatives, from the encouragement of organic farming and heritage species to the protection of unique species and the fight against GM crops and pesticides. Beyond its activities in the field, it also supports public awareness and the education of younger generations by conservation organisations.

CREATION AND INSTALLATION OF THREE ECOLOGICAL MICRO-CORRIDORS IN LILLE

The Entrelianes organisation aims to construct experimental urban micro-corridors, using a participatory approach in partnership with the residents, local organisations and public services of the city of Lille. The idea is to establish a continuum of natural gardens, plant facades, bird-houses and public green spaces. This innovative approach seeks to introduce biodiversity into the city. The Fondation has donated 6000 € in support of the planning and design stage of the project.

SAVING THE BATS

The Conservatoire du Patrimoine Naturel de Champagne-Ardenne (http://www.cpnca.org/) has undertaken a project for preserving the bat populations in the Champagne-Ardenne region. This is being funded in the amount of 3720 € by the Fondation. Beginning in 1988, this project has aimed to co-ordinate knowledge about the bats of the Champagne-Ardenne and to define a set of interlinked goals for protection, monitoring and management of the bat population.

In the Rhone-Alpes, 7300 € have been allocated for the protection of Chiroptera. In partnership with the Centre Ornithologique Rhone-Alpes, the monitoring of populations, the inventory of habitats and the reissue of a 'bats in buildings' plaque are all contributing to the conservation of this species.

BIODIVERSITY IN AGRICULTURE: A PROJECT IN MALI

In the face of the growing dominance of modern seed varieties, Malian women worry about the preservation of their traditional varieties, given that agro-diversity is the foundation of their food security and autonomy. Thanks to financial support from the Fondation Nature & Découvertes, the organisation BEDE (http://www.bede-asso.org/) runs a workshop focusing on

- Strengthening the exchange of practical expertise;
- Promoting good practices;
- Learning about agricultural biodiversity.

The Fondation Nature & Découvertes supports agro-ecology programmes in Mali

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2.1.1

Office National des Forêts

The task of the Office National des Forêts (ONF), an "Établissement Public à caractère Industriel et Commercial" (EPIC - Industrial/Commercial Public Corporation), is the multi-functional, sustainable management of the forests and publicly-owned natural open spaces which have been entrusted to it, in a financially efficient, environmentally positive and socially responsible way.

The ONF's primary responsibility is the management of national and public forests subject to state regulation. It also provides a range of other services: management, expertise and operations for the benefit of clients in the areas in which it excels, namely natural open spaces, the environment, the forestry and timber industry and land use development.

It is supervised by the two ministries of Agriculture and Ecology. It operates under a contract with the state for the period 2007-2011, which specifies the goals and outcomes to be accomplished as well as the requisite methods and operations.

The ONF has ISO 9001 and 14001 certification. It has developed environmental policies designed to limit its impacts on the environment and promote active intervention in the interests of eco-responsibility and the preservation of biodiversity, soils, water and the landscape.

THE OFFICE NATIONAL DES FORÊTS IN FIGURES

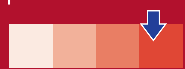
- Manages **4.6 million** hectares of national forest in mainland France
- **2.8 million** hectares belonging to **11,000** communities
- **8 million** hectares in the overseas departments, the majority in Guyana
- **10** regional headquarters incorporating a total of **66** offices in charge of close to **500** local or specialised units, plus 5 regional headquarters in the overseas departments and Corsica
- Close to **11,000** employees

SELF-ASSESSMENT

Criteria directly related to living systems

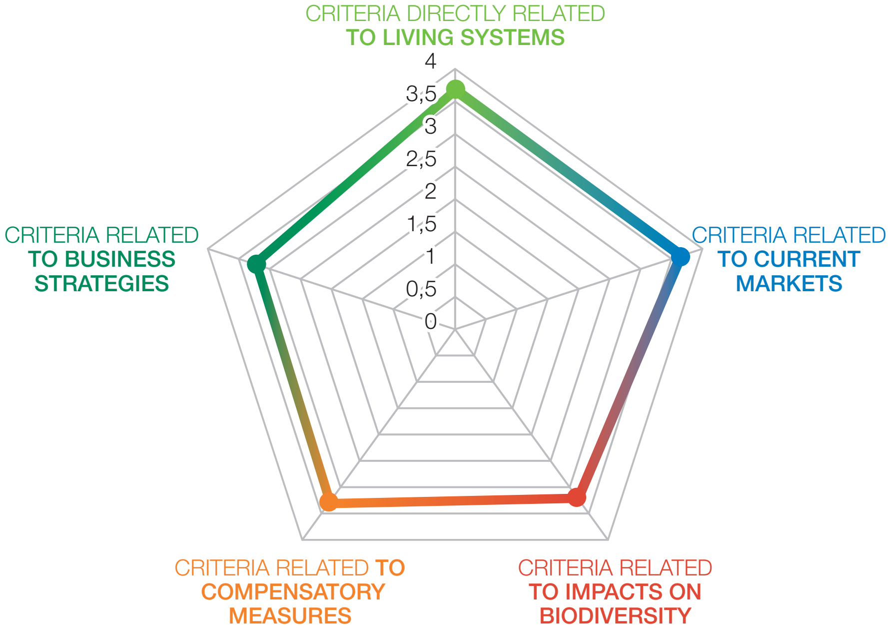
Criteria related to current markets

Criteria related to impacts on biodiversity



Criteria related to compensatory measures

Criteria related to business strategies



> *By managing more than 4.5 millions of hectares of forests, the Office National des Forêts plays a key role so as to ensure the viability of French biodiversity.*

THE INTERDEPENDENCE OF ONF WITH BIODIVERSITY

SUMMARY OF THE INTERVIEW WITH *ORÉE* ABOUT THE BUSINESS AND BIODIVERSITY INTERDEPENDENCE INDICATOR

CRITERIA DIRECTLY RELATED TO LIVING SYSTEMS

Dependence on raw materials derived from living systems

Biodiversity is everywhere present in the daily operations of the ONF, where lumbering is the core activity. With responsibility for 30% of the forest areas of France, the ONF is **extremely dependent on living systems.** By contrast, the use of **fossil resources** is limited to the oil and fuel needed to power its equipment and to heat administrative buildings.

2.1.1

Dependence on services and technologies from living systems

The ONF benefits continuously from **ecological services** in connection with its operations in forest ecosystems. In addition to **provisioning services** (mushroom gathering, hunting, firewood) and **cultural services** (sports and recreation, bird and animal watching), the organisation also derives many **support and regulatory services** from the it forests manages, including the production of oxygen, carbon storage and the water cycle. While there is no formal use of **biomimetism** by management thus far, there is a growing commitment to letting nature "speak for itself" and to encouraging the natural renewal of the forests.

Management of the variability, health and complexity of ecosystems

Changes in bio-physico-chemical parameters (storms, drought, forest fires), often related to climate change, can have a major effect on forest ecosystems, especially the growth and health of the trees. These unforeseen events can be positive, for example by extending the period of a tree's growth. But they can equally be negative, as in the case of stress caused by drought which leads to increased mortality rates for saplings, drying out of crowns and loss of leaves. The **health of forest ecosystems** is a major concern: degradation of water quality or of organic matter in the soil can jeopardize tree growth. The spread of disease and insect pests (such as the six-toothed barkbeetle on the maritime pine), as well as that of parasites on second-growth stands weakened by drought, has to be controlled. Following the gale of 1999, the downed trees were colonised by wood-eating insects, followed by lignivorous fungi which reduced the value of the timber. The **complexity of ecosystems** is a more clearly defined concept, and management methods are evolving more and more towards a preference for natural development rather than uniform tree plantations. Although calcium and magnesium amendments are occasionally introduced to correct soil imbalance, stump grinding and undergrowth removal are used in preference to herbicides. Environmental dynamics and the various levels of organisation of living systems in the forests call for biodiversity to be taken into consideration in the overall management of forest areas, not merely in a few 'model sites' carefully preserved in isolation from human intervention. The ONF sustains a number of distinct stages of forest development, up to and including stands of senescent trees which are key to the conservation of forest area biodiversity.

CRITERIA RELATED TO CURRENT MARKETS

These concern the **costs of the management and exploitation of the forests,** which comprise the bulk of the costs: the ONF has the free use of the timber and other ecological services of the forests. A small amount of raw materials from living systems is purchased - oil, fuel, seeds and seedlings. However, **market positioning** is directly linked to environmental services and related issues, not just in the everyday management of the forests but also via emerging markets. PEFC certification of publicly owned forests may be a selling point. The **commercial volume of products** from living systems is substantial, with nearly 550 million Euros received from the sale of lumber and related products. All the services ONF provides, such as research reports and training programmes, also relate to forest management.

CRITERIA RELATED TO IMPACTS ON BIODIVERSITY

The ONF's impacts on the natural environment are effectively **reversible.** The aim is to restore the forest to its previous state after resource extraction, letting nature take over again, unlike urban spaces which remain unnatural over the long term. With respect to **altering the landscape,** clear-cutting, which has a major impact on the natural environment, is forbidden. The compacting of the soil by logging equipment or by hauling away timber by cable can have significant impacts, which must be reduced. **Pollution** is produced chiefly by emissions from vehicles and equipment. Forest management is combined with respect for the plant and animal life of the area. One aspect of the ONF's job is to make a positive impact on the biodiversity of the forest. To minimise **impacts on species** and promote **ecological continuities,** ONF has made an initial assessment of the heritage entrusted to it which analyses developments and guides management plans and forestry regulation.

Hauling away pine logs

CRITERIA RELATED TO COMPENSATORY MEASURES

The **forestry code** defines the **regulatory framework** for the management of the forests of France, ensuring the sustainability of its forest heritage and preserving it for the use of future generations. The clearing of forested areas is strictly controlled and compensatory measures are required. **In addition to the regulatory requirements,** the ONF's own guidelines and forest management plans direct its pro-biodiversity activities. These define the rules governing its forestry operations and the requisite activities: pockets of senescent trees, natural regeneration of land parcels, the encouragement of a variety of species. ONF also collaborates with various partners for the conservation of heritage species typical of forest environments, such as raptors and the black stork.

CRITERIA RELATED TO BUSINESS STRATEGIES

Promoting biodiversity via appropriate forestry operations means taking into account the levels of organisation of living systems on several structural and spatial levels, as well as their development over time. While it may generate **extra management costs,** such an approach is in keeping with the ONF's diversified mandate. It can also **generate long-term gains** in terms of the resilience of forests in the face of disease or climate change. **Society's expectations** vis-à-vis the management of forests and related areas must be met. Although biodiversity has always been a concern of the ONF's operations, its **public relations efforts** on the issue have been given official form only recently. Internally, staff are becoming **better informed and trained.** Biodiversity is coming to be a key topic of forestry management and operations, and defined via indicators and standards. With respect to **emerging markets** relating to climate concerns (storage of carbon in tree-trunks, use of wood for construction and energy), balancing the different uses of the forest becomes a priority. The 'wood-based energy' sector is actively preparing to offer a substitute for petroleum. However, it is difficult to foresee the emergence of markets associated with the provision of ecosystem services such as water or biodiversity.

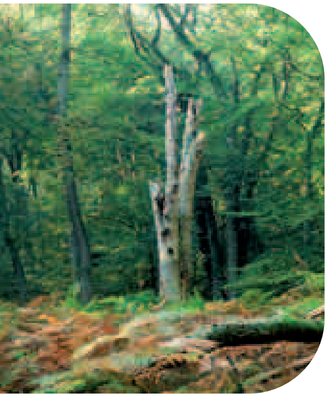
2.1.1

The steps taken by the Office National des Forêts to promote biodiversity

The ONF is committed to carrying out the first inventory of the heritage of national forests, an initiative begun as part of its contract with the state for the period 2001-2006. The goal is to provide a balanced and comprehensive overview of the effects of sustainable management of national forests in mainland France in all the diversity of their economic, ecological and social make-up. Forest planning, a medium-term management programme for each forest, is the main tool for integrating conservation and the improvement of the natural heritage into all the operations planned for the forests. This presupposes the **understanding, conservation** and **restoration** of the features which go to make up biodiversity in the forests and the habitats associated with them. The ministerial circular which defined the "national policy with respect to biodiversity in forest management" has been given concrete form by the ONF via internal guidelines for 'taking account of biodiversity in forest planning and management'. Since then, France's international relations and the progress of knowledge have helped to define the means to be adopted for a better treatment of the natural heritage represented by the forests. In 2006, ONF initiated a discussion with the CEMAGREF with a view to updating the biodiversity guidelines and introducing advances in scientific knowledge into its practice. Other documents pull together details defining overall environmental policy, such as logging regulations, a list of the services offered by ONF and technical specifications for forestry work. Environmental policies defined in the course of applying for ISO 14001 and PEFC certification spell out its environmental commitments.

FORESTRY PRINCIPLES PROMOTING BIODIVERSITY

Whatever the specific objectives and type of forestry work selected in the case of a particular forest, a group of overall forestry principles is applied, in accordance with national directives. They are designed to put the precautionary principle into practice.



- A mix of various tree species is desirable alongside one or more primary species chosen depending on current objectives. Local species and ecotypes are retained as secondary species and in small stands of trees.
- Maintaining a mixture of trees of varying age, in addition to its many advantages (even distribution of felling and tree maintenance over time), avoids creating 'bottlenecks' on a local level which can result in the loss of an ecological niche or species.
- Relying on natural regeneration as far as possible, while avoiding excessive interventions to achieve complete regeneration, leads simultaneously to the preservation of local genetic resources, the retention of small openings in stands of trees and lower management costs.
- Retaining senescent and dead trees in all the stands makes up in part for the felling of the majority of trees at an optimal age, commercially speaking, which interrupts the full genetic cycle. Dead and senescent trees provide shelter and

Fallen trees in a completely protected area of Fontainebleau (77) food sources for a range of wildlife (including cavernicolous species and insects). A balance must be struck with the health and safety risks to the public which these practices may entail. When warranted, small single stands of trees are maintained up to a very advanced age or until they collapse entirely, in order to enrich the forest biologically.

- Ecotones (transition zones) play an important role in the overall resource wealth of a forest. The existence and continuation of certain species depend on their presence and development. Special forestry methods are recommended along watercourses and wetlands, and to maintain forest edge areas.

A MAJOR PLAYER IN NATURA 2000 IN FRANCE

By the end of 2007, sites designated by France as falling under the Habitats and Birds directives covered more than 6.8 million hectares, of which public forests accounted for 19%, that is nearly 1,260,000 ha, or 37% of the surface area of the national forests. The ONF is involved in the designation of additional sites, mainly for bird sanctuaries. The goal is to increase the number of sanctuaries to create a network effectively protecting the habitats of the birds which are most threatened across Europe. ONF is the primary contributor to the preparation of goal-setting documents (with responsibility for 20% of these documents), which define conservation management operations to be carried out in the Natura 2000 zones. It also seeks to move toward the signing of charters and management contracts with the state relative to public forests, in order to implement the measures advocated by the goal-setting documents.

MANAGEMENT OF PROTECTED AREAS

Biological reserves and nature reserves are among the ONF's major initiatives in promoting forest biodiversity. These protected areas, which cover 360,000 ha of public forest (188,000 ha of nature reserves of which 180,000 are outside mainland France, 184,000 ha of biological reserves of which 146,000 RB are outside mainland France), make the ONF a major player in the creation and management of protected areas, both in mainland and overseas France. It has consequently decided to strengthen its collaborations with Réserves Naturelles de France, which brings together the country's managers of protected areas nationwide.
In addition, it has been developing a network of biological reserves for over 30 years. These divide into two types:

- Completely protected biological reserves, in which any human intervention that might alter the environment is prohibited. The purpose of these reserves, 'real world' laboratories, is to make it possible to study the natural evolution of the forest ecosystem and the biodiversity associated with it.
- Planned biological reserves, managed in order to protect species or environments of considerable heritage value.

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2.1.1

phytorestore® eau/sols/air jardins filtrants

for air, sol & water, filtering garden is a designed lanscape treating pollutants

Phytorestore constructs Filtration Gardens (Jardins Filtrants®), areas of land designed to treat pollution. They are constructed mainly on recovered wetlands.

Filtration Gardens have been installed in France and abroad. The pollution treatments offered by Phytorestore cover all types of industrial waste, from the food industry to chemicals and steel manufacture.

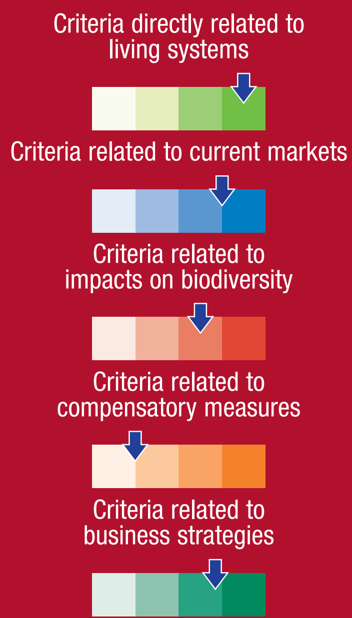
Phytorestore relies on the experience of a multidisciplinary team which includes engineers and designers (landscapers and architects). The company works with several partners, including consultants (Site and Concept) and architectural and engineering firms.

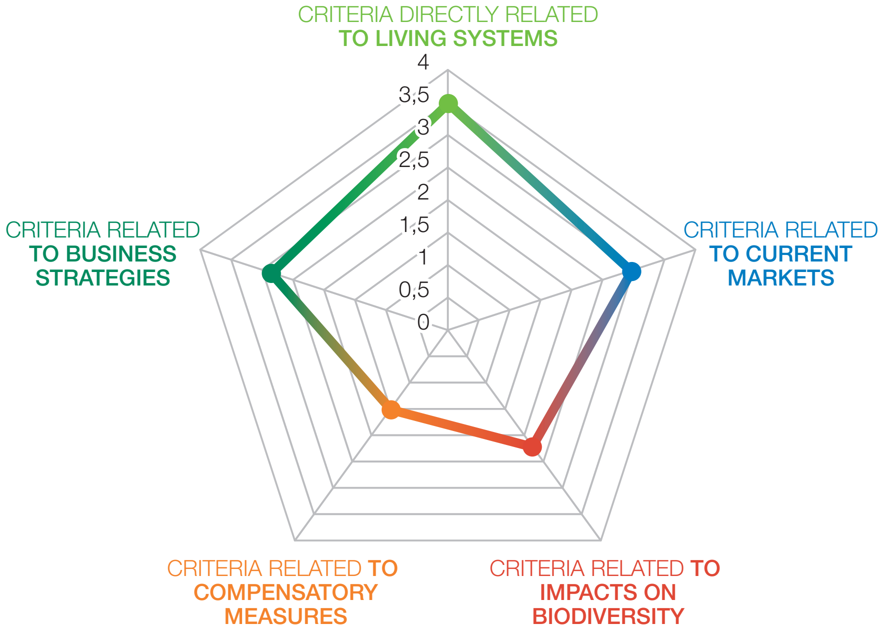
LThe clientele is very diverse, including municipalities, property developers, industries and public-sector urban design firms.

PHYTORESTORE IN FIGURES

- Sales of **3M** €in 2007
- Headquarters in Paris with an office in China
- **18** employees in France, **4** in China

SELF-ASSESSMENT





> *Phytorestore utilises plants and micro-organisms as the primary agents in the treatment of water, air and ground pollution.*

THE INTERDEPENDENCE OF PHYTORESTORE WITH BIODIVERSITY

SUMMARY OF THE INTERVIEW WITH *ORÉE* ABOUT THE BUSINESS AND BIODIVERSITY INTERDEPENDENCE INDICATOR

CRITERIA DIRECTLY RELATED TO LIVING SYSTEMS

Dependence on raw materials derived from living systems

Making use of plants and their related micro-organisms is central to Phytorestore's operations. The company is directly dependent on **raw materials derived from living systems:** these specialised organisms are what make the filtration facilities work, relying on their ability to break down or neutralise the pollution-causing compounds in the soil, water and air.

2.1.1

Dependence on services and technologies from living systems

Biotechnologies - the use of living systems as pollution elimination agents - are the key to the success of the Filtration Gardens. Earthworms, for example, true recyclers of the organic matter in the soil, contribute to eliminating pollution on some sites. Drawing on its knowledge of the functioning of natural ecosystems, Phytorestore creates artificial environments. The recycling of soil nutrients and reproduction of the water cycle are two examples of ecological services performed by the facilities.

Aerial view of a Filtration Garden

Management of the variability, health and complexity of ecosystems

The success of a Filtration Garden is largely dependent on interactions between micro-organisms and plants. In the West, their effectiveness is highly dependent on **seasonal temperature variation.** The **health of ecosystems** is an important factor in developing new markets: contaminated areas are becoming more and more numerous and legislation more stringent when an industrial site is sold (pressure from the insurance companies), which generates new markets. The interactions among plants, water flows, habitat structure, the nature of the waste materials and the dynamics of biodiversity in the surrounding area are all variables which make the success of environmental engineering difficult to foresee ahead of time. The company's goal is to work with the **complexity of ecological processes** as closely as possible, but not to expect complete control over these living systems. Given the strict specifications required by its clients, the experience Phytorestore has acquired over the years (the first gardens were constructed over ten years ago) enables it to determine the scale of its facilities correctly and select the appropriate species, no matter what kind of effluent is to be treated.

CRITERIA RELATED TO CURRENT MARKETS

The **cost of raw materials derived from living systems** (plants) is negligible compared to the costs of staffing and the design and construction of the Filtration Gardens. From a **marketing** point of view, the gardens combine functionality, aesthetics and integration into the landscape. These "top of the line" facilities, developed on a rigorous scientific basis which ensures their appropriateness to their environment, are the fruit of a lengthy consultation process with the clients. The goal is **to provide a service** covered by a long-term contract, similar to the long-term contracts for water treatment typical of more conventional technologies.

CRITERIA RELATED TO IMPACTS ON BIODIVERSITY

Phytorestore's operations have no **irreversible impacts** on the natural environment. Operations consist of **creating artificial ecosystems** which function as genuine means of eliminating pollution with very little maintenance, financial outlay or expertise. It is nevertheless true that 'beautification' of the facilities, a key selling point, involves **altering the landscape.** The Filtration Gardens gradually eliminate **pollutants** in the treated water and soil. With respect to **pressure on species selection**, although the facilities require the introduction of specialised plants and micro-organisms, they also encourage the regrowth of local biodiversity (birds, insects and plants). It is important to emphasise that the Filtration Gardens may ultimately play a vital role in the **establishment of ecological continuities** in urban and suburban areas. When non-native species are used (Miscanthus, a grass from south-east Asia), for both aesthetic and practical reasons biological invasion, one of the major causes of the erosion of biodiversity, must be guarded against.

CRITERIA RELATED TO COMPENSATORY MEASURES

The company is not concerned with **compensatory measures,** legally required or otherwise. However, as a consulting firm Phytorestore may implement environmental engineering projects in conjunction with compensatory measures.

CRITERIA RELATED TO BUSINESS STRATEGIES

Biodiversity is the essential tool for the services performed by Phytorestore: ecomimetism and biotechnologies are essential to the effectiveness of the Filtration Gardens. Biodiversity is a **source of innovation** which can also be a selling point: environmental engineering is very well received by policymakers and captains of industry who are increasingly conscious of environmental issues. **To distinguish itself from the competition** and to become more competitive, Phytorestore emphasises solutions derived from living systems. The relatively low cost of the biotechnologies employed, by comparison with other more industrial techniques common in the water treatment business, is a solid argument in their favour. The effectiveness of the facilities is improving as a result of the research and experience gained over the years, especially with respect to the selection of the most effective species. This innovative approach paradoxically also hampers the further development of our operations: it is essential to be completely certain of the outcomes of pollution elimination using living organisms. This is why the model developed by Phytorestore attracts **atypical and motivated staff,** aware that they are promoting innovative solutions by making practical use of the services provided by nature.

2.1.1

The steps taken by Phytorestore to promote biodiversity

THE FILTRATION GARDEN AT ORGANON, A PHARMACEUTICALS FACTORY IN ERAGNY-SUR-EPTE (OISE, 2006)

Organon is a pharmaceuticals laboratory which hired Phytorestore to bring its effluent into conformity with the environment into which it is discharged. The effluent to be treated consists of industrial waste water, including that used for washing out storage tanks.

To meet this particular goal, the Filtration Gardens were constructed with:

- 3 vertical filters of 100 m^2 each;
- 2 horizontal filters of 100 m^2 each.

The Filtration Garden has been designed like a small factory garden, with benches and lighting. It is sited in front of some older industrial-era buildings. Particular attention was paid to landscaping around the ponds, with the aim of restoring the marshland typical of this region. More than 80 plant species provide habitat and shelter for diversified wildlife, and the landscape design features a diversity of habitats:

- Hedgerows;
- Wetland adapted to the surrounding area;
- Meadows planted with flowers and grasses;
- Groundcover planted to hide the banks of the filtration ponds.

AN ECO-NEIGHBOURHOOD OF 50,000 INHABITANTS IN WUHAN, CHINA

In 2005, as the result of a national competition launched by the Chinese Ministry of the Environment for 50 eco-neighbourhood pilot projects, the TOPEAK / Phytorestore project was selected and funded. The assignment is to construct an eco-neighbourhood of 50,000 inhabitants on 59 hectares of land in the city of Wuhan. As of now, the first tranche has been completed and the first flats are occupied.
The planning of the neighbourhoods has been focused on water and on energy saving, both major issues for the wise management of ecosystems:

- Complete recapture of rainwater and wastewater from the eco-neighbourhood is planned: this includes reusing water for washing cars and watering plants.
- Wastewater treatment involves constructing a natural landscape for the Filtration Gardens as well as ornamental plantings around the buildings. Many of the trees growing on the site prior to construction have been preserved and full-size new ones have been planted.
- Preliminary research, especially on exposure to the sun and the prevailing wind direction in summer and winter, have guided decisions about layouts and construction techniques. While many options were analysed and implemented - geothermal energy, solar panels, techniques for the insulation of the buildings - some could not be adopted due to the high cost (vegetated roof cover).

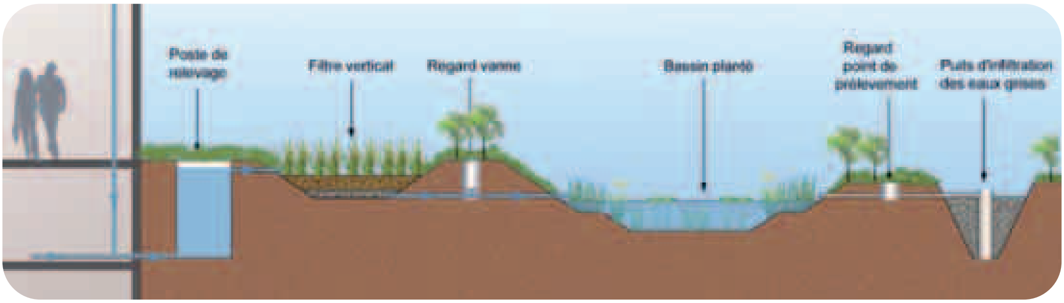
ENHANCING BIODIVERSITY IN THE FILTRATION GARDENS

The positive contribution of the Filtration Gardens to biodiversity consists in:

- The construction of artificial environments in which a rich and diversified biodiversity can flourish: birds and amphibians move in of their own accord to populate the gardens within a few weeks;
- Integration into the surrounding landscape, which promotes connectivity between habitats;
- The enhancement of the natural symbiosis between plants and micro-organisms: the idea is to partner with nature, to enhance its functional complexity.

Limitations and challenges

- Lack of space is a real limitation in installing the facilities, particularly in urban areas;
- It is hard to convince clients of the value of Phytorestore's biotechnologies, primarily because of their innovative character: *"Using plants to eliminate pollution? It sounds too good to be true!"*;
- R&D on the natural relationships between plants and micro-organisms, and on the selection of species depending on their capacity to cope with specific kinds of pollution, is an essential but expensive activity.



Treatment of greywater from dwellings.

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2.1.1

saf agriculteurs de France

Champ d'idées, terre d'entreprises

SAF-Agriculteurs de France is a Law of 1901 public non-profit association, a non-governmental organisation with a mission both in France and in Europe as a whole. Founded in 1867, its purpose is to study and promote whatever can contribute to the development of agriculture and rural areas, particularly with respect to social, technical, scientific and economic progress. This goal is split into 2 strategies:

- Assisting the directors of agricultural and rural enterprises in their work, through information, training and sharing of experience;
- Enabling the development of farm and rural enterprises and their economic, legal, fiscal, social and ecological environment, via work commissions, research studies, proposals and public pronouncements.

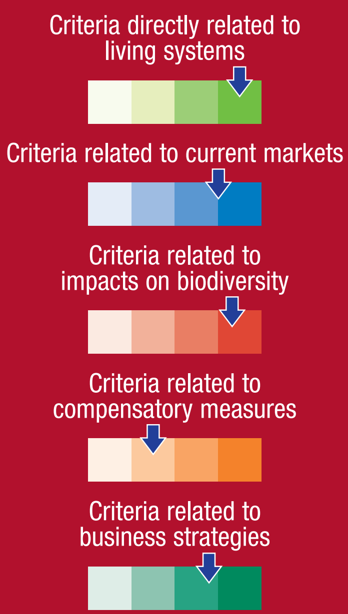
SAF-Agriculteurs de France organises its activities under three headings:

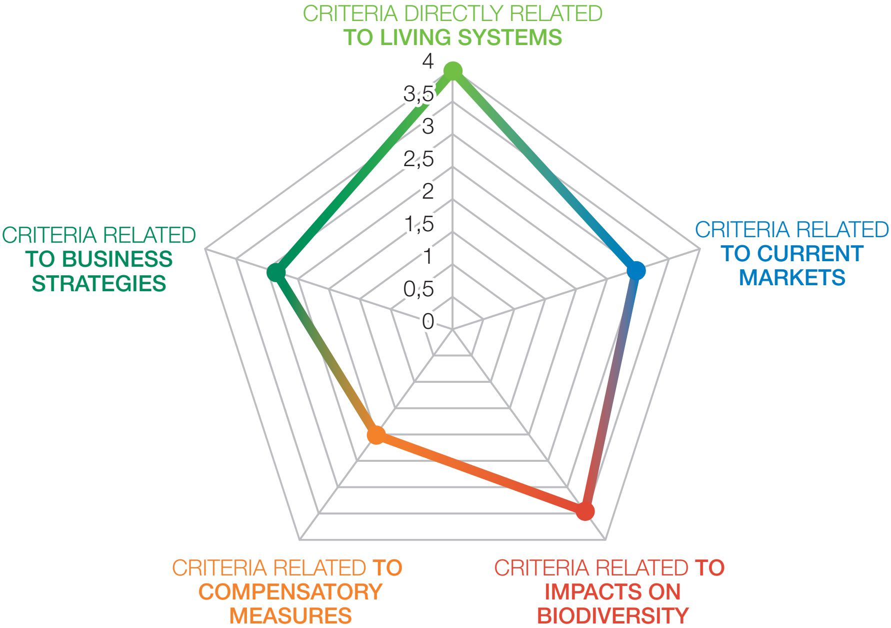
- A platform for interactions and meetings which bring its members together; they include entrepreneurs, scientists, lawyers, representatives of the public sector in France and in Europe, experts from various backgrounds, with agriculture as their common concern;
- A forum for discussions to expand our knowledge and prepare us for the world of tomorrow;
- A source of concrete proposals presented to regional, French and European policy-makers to help them strengthen the influence of their values in the agricultural and rural world.

SAF-AGRICULTEURS DE FRANCE IN FIGURES

- A team of **8** permanent staff
- Board of Directors with **24** members
- Collaboration with a number of European agriculture organisations:
  - ELO (European Landowners' Organisation)
  - DLG (Deutsche Landwirtschafts-Gesellschaft)
  - RASE (Royal Agriculture Society of England)

SELF-ASSESSMENT





> *Confronting the challenges of biodiversity, SAF-Agriculteurs de France proposes new agricultural initiatives, including the provision of environmental services to society.*

THE INTERDEPENDENCE OF SAF-AGRICULTEURS DE FRANCE WITH BIODIVERSITY

SUMMARY OF THE INTERVIEW WITH *ORÉE* ABOUT THE BUSINESS AND BIODIVERSITY INTERDEPENDENCE INDICATOR

CRITERIA DIRECTLY RELATED **TO LIVING SYSTEMS**

Dependence on raw materials derived from living systems

Agriculture is by definition an activity which **works with living systems:** it uses seeds for crop production, trees for forestry, and animals for livestock farming. Other elements directly involved in operations are the land itself, materials used in farming and manpower. Agriculture also uses **fossil resources** for agricultural equipment and fertiliser production.

2.1.1

Dependence on services and technologies from living systems

SAF - Agriculteurs de France believes that it is important for agricultural enterprises to make use of **ecological services.** Crop rotation must be adapted to take advantage of some agricultural practices that have fallen into disuse. Growing leguminous plants during the rotation cycle will fix nitrogen drawn from the atmosphere and thus reduce fertiliser inputs. In addition, animal-plant synergy is to be redeveloped: while the growing specialisation of farming in recent decades has separated these two realms, we need to learn once again how to benefit from the complementary relationships between animal and plant production, which open up numerous possibilities. Agriculture makes extensive use of **natural models and processes** in its operations. Systems for crop production are adapted from the natural cycles of plants. The same is true for the production of seeds, which is based on the laws of natural selection.

Management of the variability, health and complexity of ecosystems

Agriculture is directly dependent on the unpredictability of the living world. The **variability of ecosystems** affects agricultural production and its profitability. The variables involved are primarily temperature, precipitation, unforeseen climatic events and pest invasions. The **health of ecosystems** is also an important variable in production: the yield and overall productivity of an agricultural enterprise will be reduced if farmland is in poor ecological shape. Lastly, **ecosystem complexity** determines agricultural practice. In order to optimise its operations and select the best production methods, the enterprise has to be able to control the ecosystem in which it is situated.

CRITERIA RELATED TO CURRENT MARKETS

The **cost of resources derived from living systems** forms only one part of the totality of production costs, a significant portion being allocated to land and to other operating expenses (such as salaries). European models of agricultural production enable conventional agriculture to produce foodstuffs which are healthy in every way. Some of them are famous for their **excellent quality,** a positioning which relies on certification, as in the case of organic farming or certificates of origin such as the AOC in France and the IGP at the Europe-wide level. The **commodities produced for sale** are derived entirely from living systems. There is thus a high level of interdependency between agriculture and markets related to living systems.

CRITERIA RELATED TO IMPACTS ON BIODIVERSITY

Agriculture has a major impact on the **landscape.** In France, it takes up nearly 60% of the total land area, a national heritage which needs to be maintained and preserved. Agriculture takes serious account of the dangers of the **pollution** it may generate. New systems for agronomic management are coming to include pollution reduction measures. Precision agriculture, thanks to computers and GPS technology, is able to manage fertiliser use and phyto-sanitary protection very accurately. Agriculture also exerts **selective pressures on species.** For it to be carried on under optimal conditions, undesirable plants and animals have to be controlled. In the past the **fragmentation of rural areas** was a consequence of the restructuring of individual farms to make them compatible with modern agricultural practice. Today, in contrast, the goal is to promote habitat diversity and ecological continuity.

CRITERIA RELATED **TO COMPENSATORY MEASURES**

Cross-compliance is a condition for receiving aid under the CAP: farmers are required to comply with a series of **regulatory requirements** and to maintain the land they farm in good agricultural and environmental condition. These measures aim to limit the impact of agriculture on biodiversity, and failure to comply incurs a fine. **Beyond the regulations,** some measures are designed to facilitate the return of lost biodiversity. For example, planting hedgerows can create a refuge for the wildlife living in the fields. Other measures include simplified cultivation techniques which reduce the use of motorised machinery and hence fuel consumption. Another example is the use of integrated pest management in the horticultural sector.

CRITERIA RELATED **TO BUSINESS STRATEGIES**

The strategy of an agricultural enterprise is directly linked to its promotion of biodiversity. This plays a major role in farmers' capacity **to keep their operations going.** It can improve their added value and **competitiveness** by means of product labelling which guarantees to the consumer that the relevant criteria have been complied with. This in turn opens up the possibility of developing **new markets.** The public today is cut off from the world of agriculture: **public opinion exerts a pressure** which tarnishes the image of the farmer and does not necessarily correspond to reality, particularly in the case of problems related to biodiversity. **Public relations efforts** related to biodiversity issues must be the responsibility of farmers themselves: they are the best ambassadors of the world of agriculture. This is an issue that receives too little discussion among individual farmers.

2.1.1

The steps taken by SAF - Agriculteurs de France to promote biodiversity

Beyond its primary mission of feeding humanity, agriculture today has to take on some new missions: food security, preservation of the environment and the care of animals. It thus goes without saying that concerns related to biodiversity are becoming more and more pressing. SAF - Agriculteurs de France assists farmers to cope with these new challenges.

NEW TASKS FOR AGRICULTURE

Meadowland, treeless land and biodiversity
In farmed and mountainous areas, farming activities help to maintain treeless land, thus limiting or preventing forest fires. Permanent meadowlands form significant carbon sinks and biodiversity preserves. Farming operations in intermediate and fragile areas (ecotones) are a social and economic necessity which communities ought to support.

Recycling urban and industrial waste
Disposal of urban waste is an increasingly pressing concern. Given the various options for getting rid of it, including incineration, using it to manure farmland ought to become a preferred solution. Recovered sludge and compost from modern biological treatment of household waste is of good enough quality to be used for soil amendment. Farmers may find this has several benefits: among other things it contributes organic matter and nutrients to the soil. The ban on spreading sludge produced by sewage treatment plants on farmland may be cutting off options for farmers who would be ready to make use of it. By agreeing instead to fertilise their land with urban waste, while making sure that the soil and environments which receive runoff from their fields remain ecologically healthy, farmers could provide a real service to society, contributing to the preservation of an industrial ecology which is shared by all.

The greenhouse effect and climate change limitation
With respect to the greenhouse effect, agricultural operations, unlike other types of business, can create carbon sinks, since carbon is sequestrated via photosynthesis in areas of vegetation. Under the implementation of the Kyoto Protocol at a national level, the collective carbon market now being established represents an attractive opportunity which the agricultural sector ought to grasp, as long as it can be sure that the measures proposed to implement it are consistent with protection of the environment.

FARMERS AS SUPPLIERS OF ECOLOGICAL GOODS AND SERVICES TO SOCIETY

The positive and negative impacts of agriculture on the environment are manifold and complex. On the one hand, the pressures of farming on the environment are felt on water supplies in the form of pollution by nitrates, phosphates and pesticides; on the soil in the form of erosion; on the air in the form of methane and ammonia emissions; and on biodiversity. All of these harms result in the incurring of costs for the elimination of the pollutions in question. On the other hand - and this role is certainly not adequately valued - agriculture is a source of environmental benefits, such as carbon storage in the soil and the preservation of open spaces, among many others. These benefits should be emphasised by the agricultural community, because they provide services to society. This is true in the case of the landscape, which has largely been created by farmers. In the tourist industry the heritage of the countryside is a source of real commercial value.

Often regarded as a constraint in the management of agricultural enterprises, the environment can become a true asset, a source of opportunities. Agriculture is involved in the provision of environmental goods and services for which it ought to be rewarded: the provision of open land rich in biodiversity and of biomass for green energy, helping to combat global warming by maintaining carbon sinks and helping to recycle urban waste are all services that agrosystems can offer.

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2.1.1

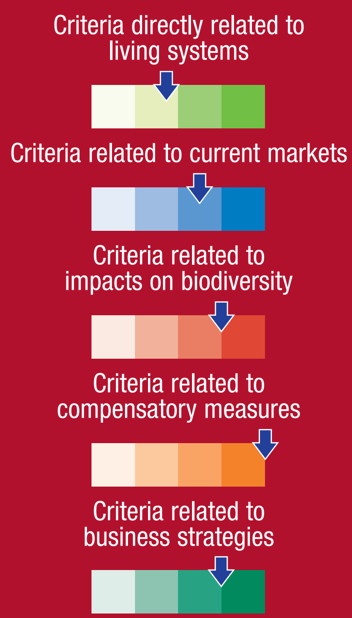
Séché environnement
Séché global solutions

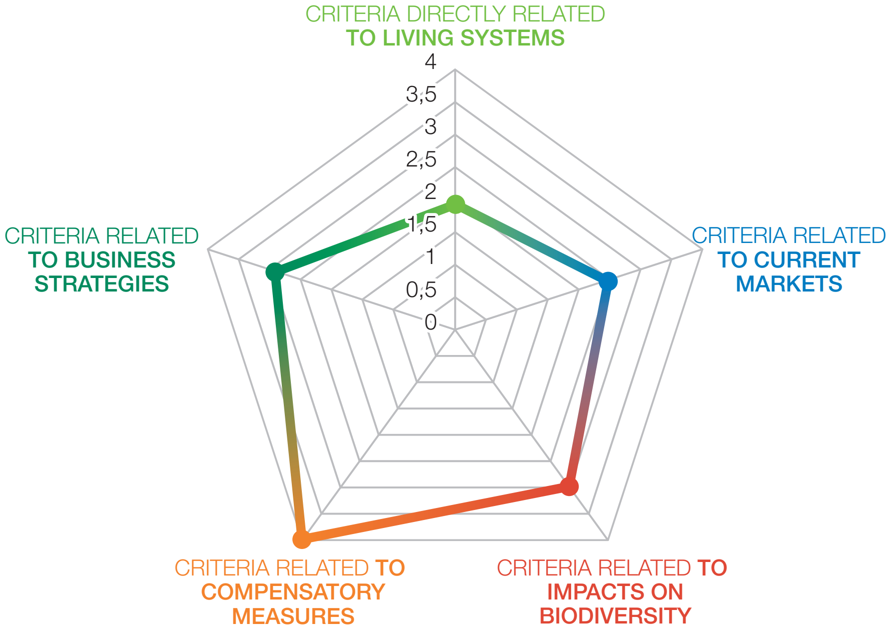
A major French company in the waste recycling and processing sector, Séché Environnement offers a wide range of solutions for sound environmental and waste management. Through its expertise in the entire processing sequence and its unique positioning in the provision of eco-services, the company offers a solid guarantee that the generator of the waste will meet its legal responsibilities, from the point of collection up to final disposal.
Séché Environnement's core function is the treatment of the pollution generated by human activity and the development of methods for recycling waste, including thermal processing, storage with waste-to-energy facilities and techniques specific to certain types of waste.
Séché Environnement is deeply involved in environmental issues in general and in the preservation of biodiversity in particular. Each of the techniques used for the treatment of waste, such as incineration and storage, has environmental impacts specific to it which the company has to manage in order to avoid any potential harm to biodiversity.
The commitment includes reducing water consumption, the use of raw materials derived from waste recycling and continuous managing of waste release into the environment by means of systems for monitoring outflows and bio-monitoring using lichens. Respect for biodiversity is also expressed through the targeted management of different areas and monitoring via the use of complementary biological indicators.

SÉCHÉ ENVIRONNEMENT IN FIGURES

- 2007 sales of **374M €**
- A staff of **1520** salaried employees
- **266 kT** of waste recycled
- **84 000 €** allocated to protection of biodiversity and the landscape
- **206,5 GWh/year** of energy consumed versus **186.2 GWh/year** of energy produced, resulting in **90.2%** self-sufficiency in energy

SELF-ASSESSMENT





> *“Managing biodiversity means first and foremost preserving the ecological potential of property assets and ensuring that they are integrated into the landscape as a whole.”*

THE INTERDEPENDENCE OF SÉCHÉ ENVIRONNEMENT WITH BIODIVERSITY

SUMMARY OF THE INTERVIEW WITH *ORÉE* ABOUT THE BUSINESS AND BIODIVERSITY INTERDEPENDENCE INDICATOR

CRITERIA DIRECTLY RELATED TO LIVING SYSTEMS

Dependence on raw materials derived from living systems

Apart from paper, coffee and furnishings for its administrative services, and seeds and plants for the targeted management of storage sites, Séché Environnement consumes very few **raw materials derived from living systems.** Like many other industries, the company depends on **fossil fuels,** chiefly for earth-moving operations and the transport of equipment and people.

2.1.1

Dependence on services and technologies from living systems

Although water consumption is relatively high, amounting to about 4 million cubic metres per year, mainly at the thermal processing sites, it is hard to identify any dependence on free **ecological services** derived from ecosystems. The recycling of organic matter is performed in large part by soil micro-organisms, a form of biotechnology. We might also mention **ecomimetism,** meaning in this case industrial ecology techniques, with respect to (a) the generation of electricity after thermal waste processing and (b) the recovery of biogas energy from decomposing waste at the storage sites.

Management of the variability, health and complexity of ecosystems

The **variability and unpredictability of ecosystems** have no direct impact on the company's operations, except in the sense that they provide it with a complementary business activity, the elimination of pollution on contaminated sites owned by third parties. In contrast, the **health of ecosystems,** both on its own industrial sites and its clients' construction sites, is a major concern. The **complexity of ecosystems** is analysed individually at each site so as to identify and understand fully the interactions between the company's operations and the impacts and changes in the living systems for which it bears responsibility.

CRITERIA RELATED TO CURRENT MARKETS

The **processing of waste,** which can contain a high percentage of **organic matter,** is the core of the company's activities. That is, Séché Environnement is directly concerned with the final stages of existence of many substances derived from living systems. Although biodiversity is not yet in and of itself an advantage in terms of **market positioning,** the conservation of the natural heritage which is practiced at its processing sites means that nearby residents and local authorities are more willing to accept their presence.

CRITERIA RELATED TO IMPACTS ON BIODIVERSITY

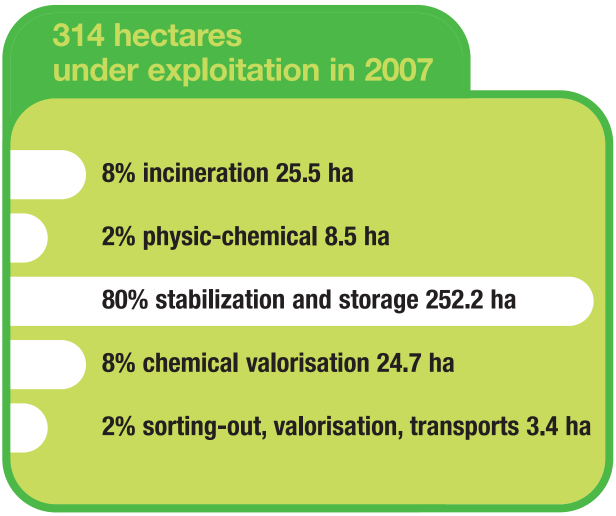
With respect to the **reversibility of impacts,** Séché Environnement does not foresee that its processing sites can ever be returned to their original state. It seeks to meet the expectations of its stakeholders, who are conscious of the societal value of its operations, by way of the rehabilitation of its properties. In a number of cases the company goes beyond existing regulations by setting itself ambitious targets for monitoring animal and plant species. **Respect for the integrity of the landscape** is a key point in gaining acceptance by local residents, for example the efforts made to integrate the Changé site into the rural landscape of fields and hedgerows typical of Mayenne. Consultation with ecologists in the planning and implementation of daily operations, consistency of operations from a scientific point of view and the monitoring of results all demonstrate the quality of its integrated approach. With respect to the **management of pollution and waste,** the company is active on several fronts and goes beyond regulatory requirements: waste-to-energy recycling, systematic recovery of water and treatment of leachate in the storage sites by outflow through filters. It is also concerned with **maintaining species diversity** in the natural areas around the storage sites. This is accomplished via targeted management of the areas, with active intervention in the most sensitive ones. Although the processing sites occupy substantial tracts of land, the company is determined to minimise **landscape fragmentation** and to create ecological continuity. The introduction of sensitive ecological areas, genuine biodiversity reserves within the boundaries of the sites, leads in turn to the rehabilitation of surrounding areas which have been altered by earth-moving operations.

CRITERIA RELATED TO COMPENSATORY MEASURES

Compensating impacts is both a **legal requirement** and a **voluntary commitment** over the long term. Significant human and financial resources are devoted to it each year. Séché Environnement implements ambitious projects designed to integrate its storage sites into the landscape. A team works on their targeted management in order to protect the environmental heritage. **Sponsorship initiatives** are also undertaken, such as the restoration of the major greenhouses at the National Museum of Natural History Jardin des Plantes and the participation in the national STOC (Suivi Temporel des Oiseaux Communs) programme. Another example is the botanic gardens being installed on a plot of about 8 hectares inside the Changé storage site. In addition to their ecological role, they will be economically valuable, by improving the company's image, and socially useful, as the gardens will be open to the public.

CRITERIA RELATED TO BUSINESS STRATEGIES

The enhancement of biodiversity is a major focus of the company's **strategy for sustaining its operations.** Taking account of biodiversity is necessary in the light of the **growing community pressure** on an industry to which local communities are often hostile. In the short term, biodiversity generates **additional costs** for the management of sites, especially with respect to the human resources required and the planning of new projects, such as the postponement of earth-moving operations if an organism's life cycle demands it. Even though the benefits resulting from such an approach are difficult to quantify, the company has chosen to **anticipate future regulations** and **minimise the risk of future additional costs.** However, biodiversity is proving to be a major asset for both **external public relations** and **in-house communication.** Intelligent environmental management at the treatment sites makes it possible to incorporate stakeholders' demands. Although biodiversity is not a source of **new markets** at this stage, it is a topic that brings employees together. Night-time field trips and meetings with site managers are designed to raise consciousness on the topic: the goal is to work differently and develop a genuine **corporate culture.**



Land use and waste disposal breakdown at the Changé site in Mayenne.

2.1.1

The steps taken by Séché Environnement to promote biodiversity

TARGETED MANAGEMENT OF STORAGE SITES

Targeted management refers to the methods and techniques of maintenance and planning for green and natural areas, designed to improve the quality of the landscape, particularly by diversifying it and avoiding the use of pesticides. A 'targeted management' directive unique to Séché Environnement sets out the recommended methods. Starting from the initial conditions, with a detailed description of plant and animal life, it specifies the interventions to be implemented in each area, as well as the long-term monitoring required to measure the results. In 2007 a team of employees in charge of the natural areas at the company's four storage sites was trained in the practices to be adopted. The initiatives of the last several years include:

- The conservation of meadowland and pastures, in order to maintain diverse biotopes by optimising the capacity of the environment to support birds, mammals, insects and reptiles or amphibians;
- Pastoral farming, introduced into sensitive ecological areas with herds of Highland cattle;
- Creating flowering meadows via an appropriate choice of seeds; this makes the site visually appealing, while also developing environments attractive to bees;
- Selecting native berry-bearing shrubs for the planting programmes, intended especially to attract birds;
- Preserving fallen branches and trees as part of the maintenance programme, to provide shelter and food for insects, bats and micro-fauna;
- Mulching grassy areas, to fertilise the soil using cuttings and prevent it from drying out.

This type of management of green spaces seeks initially to preserve the natural heritage already present. In the future, genuine enrichment of the diversity of plant and animal life in the protected and rehabilitated areas is planned. Moreover, this approach allows for the transfer of experience to other sites belonging to the company. At Montech, a site owned by its subsidiary Drimm, landscape modification in 2007 has accomplished

- The installation of 5,660 plants over an area of 3.4 hectares, the equivalent of 9.5 km of linear plantations;
- The planting of 2.8 tonnes of seeds over 140,000 square metres.

INTEGRATING THE SITES INTO THE SURROUNDING LANDSCAPE

At the Changé site, a sorting centre and a mechano-biological unit are being constructed to "High Environmental Quality" standards (HQE Label) with the goals of:

- Integrating a very large building into the landscape: the solution takes the form of vegetated roofing using several varieties of succulents;

- Optimising the use of rainwater: the rainwater management equipment is moved up from the basement of the building to the vegetated roof. The roof, able to store 40 litres per square metre, thus helps regulate the water flow at times of heavy rain;
- Preferring renewable materials, such as wood from local forests, which is not pressure-treated.

Integration into the surrounding landscape is a key concern in the rehabilitation of storage sites. Here, the site at Changé in Mayenne, France

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2.1.1

Société Forestière
Faire de la nature une valeur sûre

UNE FILIALE
Caisse desDépôts

The Société Forestière is a subsidiary of the Caisse des Dépôts et Consignations (CDC). Founded in 1966, it is now one of the primary organisations in charge of the management of forests and other natural areas. Managing over 230,000 hectares of forest on behalf of major businesses (banks, insurance companies) as well as groups and individuals, the Société Forestière is naturally concerned with environmental questions.

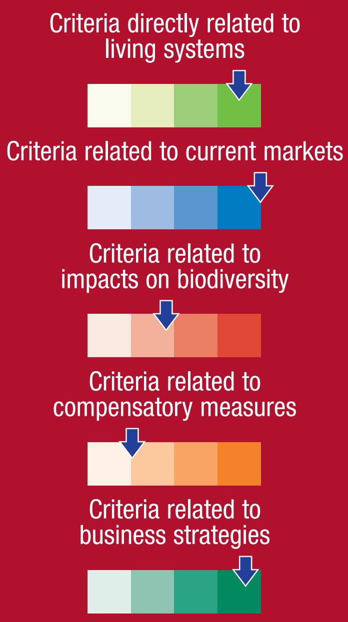
Since 1995 it has been introducing a variety of responsible management procedures both for its clients, via the sustainable forest management charter and eco-certification of forests, and for itself, with ISO 9001 certification.

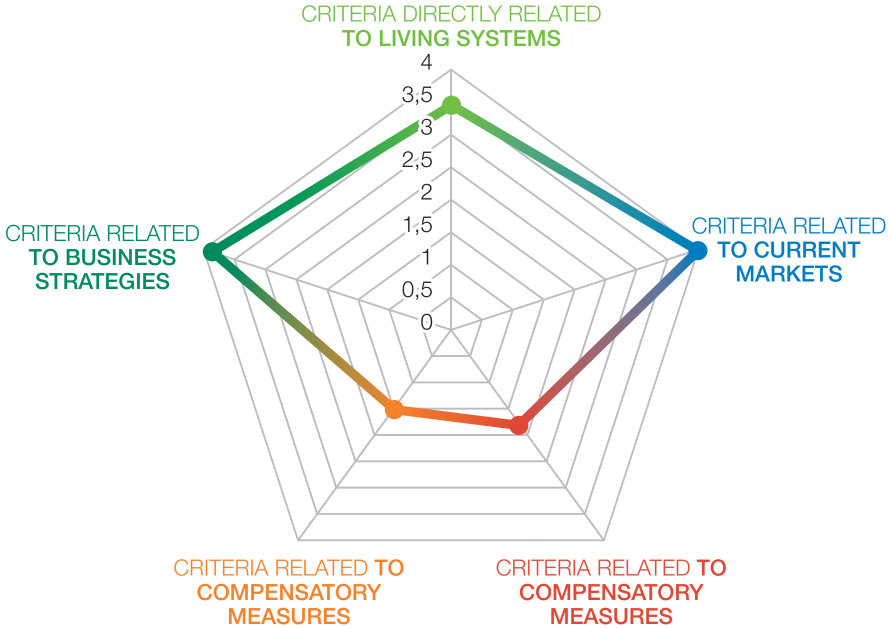
In 2004, drawing on its experience as a leader in the CDC's Climate Mission, a project focusing on the carbon economy, the Société Forestière launched a series of probing discussions on the issue of the financing of biodiversity. In 2006 this led to the creation of a Biodiversity Mission; two years later, on February 19 2008, it was followed by the introduction of a new CDC subsidiary, CDC Biodiversity, directed and managed by the Société Forestière.

THE SOCIÉTÉ FORESTIÈRE IN FIGURES

- Over **1 billion** in assets managed
- **235 000 ha** including more than **1,000** forests managed in close to **70** departments
- **8** branches, **15** forestry experts and **135** specialists in investment in and valorisation of nature

SELF-ASSESSMENT





> *As the managers of a substantial forest heritage, the Société Forestière works on a daily basis with living systems.*

THE INTERDEPENDENCE OF THE SOCIÉTÉ FORESTIÈRE WITH BIODIVERSITY

SUMMARY OF THE INTERVIEW WITH *ORÉE* ABOUT THE BUSINESS AND BIODIVERSITY INTERDEPENDENCE INDICATOR

CRITERIA DIRECTLY RELATED TO LIVING SYSTEMS

Dependence on raw materials derived from living systems

The services provided by the Société Forestière are varied and complement one another. They include the management of forests and natural areas, consulting on investment in forests and landscaping work. Its entire operation is closely linked to **living systems.** Its operations are also dependent to some extent on **fossil fuels** consumed by the transport of its technical teams through the forests.

2.1.1

Dependence on services and technologies from living systems

Forest ecosystems play a key role in the range of environmental functions: the regulation of climate (temperature, humidity, CO_2), the water cycle, soil formation and alterations in organic matter. In implementing sustainable forest management, the company is attentive to the proper functioning and maintenance of these **ecological services.** How to make these links more visible and effective is still an only partly resolved issue, as is emphasised in the reports of the Millennium Ecosystem Assessment. With respect to new developments, the Société Forestière is focusing on carbon storage, and CDC Biodiversity will explore other types of ecological service.

Management of the variability, health and complexity of ecosystems

Forestry work is closely correlated with the **variability of environmental factors:** the storm of 1999 had a widely felt impact on operating income. The correlation, however, is a complex one, as a single factor can have both positive and negative effects on resources. The climate change we are experiencing, for example, tends to increase the amount of CO_2 in the atmosphere, which promotes the increase of tree populations. At the same time it can cause droughts, which lead to declines. We find the same kind of dual effect in the case of biotic factors, in particular with respect to defoliating insects and other pests.

CRITERIA RELATED TO CURRENT MARKETS

As a **company which provides services,** the Société Forestière is not involved in the processing of timber or the marketing of finished products. Consequently, it does not **position itself** in a market determined by the cost of purchasing raw materials from living systems, the cost of processing them and the retail price. **Company revenues** are nonetheless closely linked to living systems, since the price of the services provided by the Société Forestière (acquisition, sale of land, sale of timber) is directly indexed to the price of timber and of land.

CRITERIA RELATED TO IMPACTS ON BIODIVERSITY

Forest management operations affect the **evolution of forest ecosystems.** The felling of trees, a 'radical' operation, is planned within the context of appropriate planning, approved by top management and in compliance with the sustainable forest management charter which the Société Forestière has adopted. We should also note that tree felling is a positive operation from the point of view of many species which require open spaces to live. By diversifying its forestry practices (both regular and irregular interventions), the Société Forestière takes care to maintain the **structural heterogeneity** of the forests, which promotes biodiversity. The **choice of tree species** to be planted is another crucial factor.

On this question, the company makes its decisions by taking into account the bio-geographic features of the land areas to be affected by reforestation, while respecting the particular ecology of the individual tree species. Forestry methods have been the major cause of potentially adverse effects on ecosystems. Forest management has made considerable progress in this regard, by restricting as far as possible **external inputs** and **manoeuvres.** The Société Forestière is certified ISO 9001 for its operations and PEFC for the forests it manages.

CRITERIA RELATED TO COMPENSATORY MEASURES

The Société Forestière does not own land or forests. It does not bear the administrative responsibility for clearing operations or modifications of land use, both of which require authorisation which may entail compensatory measures. It is thus not directly affected by legal requirements. However, with the launch of CDC Biodiversity in February 2008, the company offers to clients of all kinds a range of services designed to implement **compensatory measures** in the case of residual impacts of land development projects.

CDC Biodiversité

CRITERIA RELATED TO BUSINESS STRATEGIES

Operations in support of biodiversity are key to the **market strategies, development** and **communication** of the Société Forestière. Initiatives to promote biodiversity are essential to continuing its traditional operations, developing new fields such as biomass and CO2 storage, or **new businesses,** such as CDC Biodiversity. In pursuit of these goals, the company has earned PEFC certification for the forests it manages and ISO 9002 certification of its own operations; it has drawn up a sustainable forest management charter approved by the non-profit sector, and partners with various nature conservation organisations. These concrete approaches reflect both the determination to keep its **employees committed** and the desire to be an exemplary enterprise, one which satisfies the needs of clients who are demanding when it comes to sustainable development and the conservation of natural resources.

2.1.1

The steps taken by the Société Forestière to promote biodiversity

PARTICULAR ATTENTION PAID TO BIODIVERSITY IN FOREST MANAGEMENT

Taking account of biodiversity is a high priority for the Société Forestière. It entails ongoing assessment of its practices with a view to refining existing procedures in the areas of management, protocols for monitoring and evaluation, and the education and training of staff and clients. In this context, the Société Forestière has adopted several practices:

- Leaving unusual trees to age naturally;
- Creating zones of natural development, that is, with no intervention, in forests of particular ecological interest, ranging from 0.2 to 40 hectares in area;
- Undertaking targeted operations appropriate to the ecological characteristics of a particular forest: habitat conservation (wetlands, riverbank woodland) and species conservation (the European mink, spotted salamander, royal fern, black woodpecker).

CREATION OF CDC BIODIVERSITY, THE FIRST BIODIVERSITY BUSINESS IN FRANCE

The Société Forestière is the impetus behind the creation of the first business dedicated to biodiversity in France, which has functioned since February 2008 through CDC Biodiversity, a first-rank subsidiary of the Caisse des Dépôts with starting capital of 15M Euros.

The primary core function of CDC Biodiversity is to assist contractors, businesses and communities in their efforts to promote biodiversity, including the obligation to compensate for the residual impacts of development projects, in accordance with the legally binding three-part injunction "avoid, reduce, offset" (Law for the Protection of Nature, 1976). The subsidiary offers project management services for the thorough implementation of compensatory measures: technical and scientific feasibility studies, land security, project specifications, operational implementation, monitoring and reporting. It is also able to carry out projects of restoration, rehabilitation, recycling, recovery and management of biodiversity conservation over the long term.

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2.1.1

Founded in 1972, Solabia specialises in the manufacture and supply of raw materials, active ingredients and reagents for microbiological diagnostics in a wide range of applications. Operating in the cosmetics, pharmaceuticals, nutrition, diagnostics and biotechnology sectors, Solabia possesses a solid body of expertise in the fields of fine chemicals, plant extraction and microbiology.

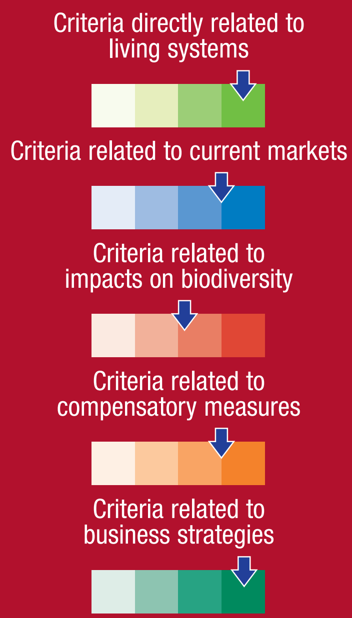
Solabia's headquarters are in Paris, but it has expanded to become an international presence. It relies on a network of distributors whose operations it co-ordinates so as to ensure consistent quality of service on all five continents; its international reach is exemplified by the Solabia Do Brasil research and production centre, located in Brazil in the State of Paraná.

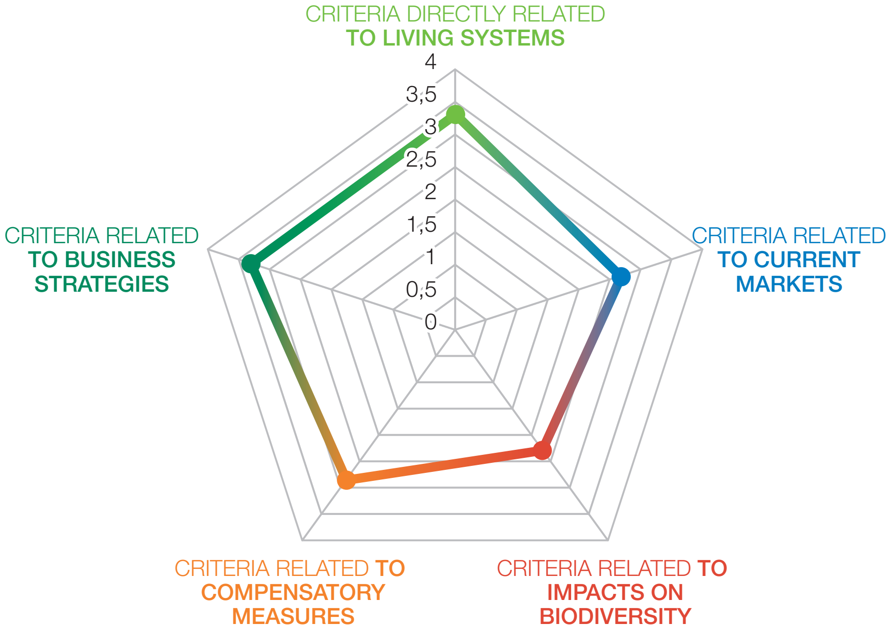
In 1995 this subsidiary, which designs, develops, produces and markets plant extracts and active ingredients, began in-depth discussion of the challenges of biodiversity. Based on this work, Solabia subsequently developed several partnerships aimed at protecting the biodiversity of the Mata Atlantica.

SOLABIA IN FIGURES

- 2007 sales of **45M €**
- **280** employees worldwide
- **5** factories and 3 Research and Development centres including **one** in Brazil

SELF-ASSESSMENT





> *Biodiversity is at the core of Solabia's expertise: most of its raw materials, active ingredients, reagents and modelling are derived or adapted from living systems.*

THE INTERDEPENDENCE OF SOLABIA WITH BIODIVERSITY

SUMMARY OF THE INTERVIEW WITH *ORÉE* ABOUT THE BUSINESS AND BIODIVERSITY INTERDEPENDENCE INDICATOR

CRITERIA DIRECTLY RELATED TO LIVING SYSTEMS

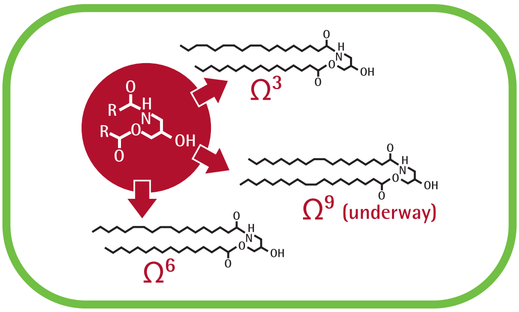
Dependence on raw materials derived from living systems

Raw materials derived from living systems are central to Solabia's manufacturing processes: they include active ingredients (oligosaccharides and polysaccharides), materials derived from plants (herbal extracts, exfoliation powders, hydrolysed proteins) and chemicals synthesised from natural ingredients (seeds, vegetable oils). To a lesser extent, packaging and the transport of goods and staff consume petrol and other derivatives, that is, resources derived from **living systems of past eras.**

2.1.1

Dependence on services and technologies from living systems

Sourcing depends entirely on the **provisioning services,** water and unprocessed raw materials. It is harder to link support and regulatory ecological services to the company's operations. The importance of the water cycle and of soil formation for the growth of plants from which many active ingredients are derived is clear, but how to quantify this dependence? On the other hand, **biomimetism** is an important method with a major role in product innovation. For example, Solabia produces a biomimetic active ingredient for rebuilding and protecting the skin, Omega Céramide ®. This consists of a ceramide analogue obtained by a patented process of enzyme synthesis using a vegetable oil.



Omega Céramide® obtained by enzyme synthesis, an example of biomimetism

Management of the variability, health and complexity of ecosystems

The supply of raw materials is subject to **seasonal fluctuation:** harvesting the materials, in France and abroad, depends on flowering cycles and crop readiness, while on the sales side client order volume needs to be predicted and planned for. The concept of **ecosystem health** is of greater concern to our suppliers and their harvesting and production methods. It is intuitively obvious that a healthy ecosystem enables wild plants to thrive and to be more resilient in the face of the pressures of harvesting. While interdependence with the **complexity of ecosystems** is seen as important, especially for purposes of innovation (new active ingredients, biomimetism), its very nature makes its assessment and formal recognition difficult for the company.

CRITERIA RELATED TO CURRENT MARKETS

The **cost of raw materials from living systems** varies according to the product range and type of active ingredient in question. An extract from an exotic tree species can be particularly costly, whereas active ingredients derived from blueberries or lemons are not. Environmental concerns are more and more reflected in **market positioning.** Some rare products, affected by intensive extraction methods or brought from a great distance, are a focus of attention with regard to respect for biodiversity: they can produce a significant profit margin. Lastly, it should be noted that a **portion of revenue** is derived from the sale of biotechnologies.

CRITERIA RELATED TO IMPACTS ON BIODIVERSITY

The land area occupied by Solabia factories in France is not extensive but is probably **irreversible,** because it is located within predominantly urbanised areas. Although **the integration of its sites into the landscape** is important for the company, there are no concrete methods and opportunities available to implement this. The **generation of pollution** varies across its production sites: Solabia strives to conform to the regulatory limits set for effluent processing stations. With respect to **impacts on the distribution of species,** efforts are being made to establish a standard procedure for the traceability of raw materials, to identify their sources and the state of conservation of the species harvested. While relatively small quantities of living materials are collected, the company's impact with respect to **habitat fragmentation,** probably negligible, is difficult to evaluate.

CRITERIA RELATED **TO COMPENSATORY MEASURES**

Some areas of operation are little affected by required **compensation measures.** Voluntary compensation measures are implemented in the countries of origin of the raw materials derived from living systems. Solabia, continually in search of new active ingredients derived from plants, has every reason to support the sustainable production of desirable tree species. Repopulating existing plantations of valuable species or planting new ones can be beneficial for biodiversity. In Brazil, the new factory will be "carbon-neutral": the CO_2 emissions generated during its construction will be offset by reforestation.

CRITERIA RELATED **TO BUSINESS STRATEGIES**

Since 1995 Solabia has been conscious of the importance of preserving resources derived from living systems if it is not to jeopardize its future. In the process of inventing and launching any new product, taking ecosystems into account is crucial for **cost control** in the sourcing of wild plants from which ingredients are derived. Their origins must therefore be known, and the habitats where the plants are to be gathered must be properly managed. These operations also reflect some clients' requests for **traceability** of ingredients. Product ranges which are certified or "organic" are real assets in the cosmetics industry, and form an **expanding market.** Solabia bases part of its **external public relations** message on ethnobotany, in accordance with the needs of its clients. This makes sense given the nature of its operations. The company does not deal directly with retail customers, but acts as a middleman in the **supply chain.** Although the term "biodiversity" is often invoked, the implications of the concept and its expression in everyday practice still remain to be explored and developed. At this point it is chiefly ethnobotany which is explicitly addressed: this concept, responding to **consumers' desire** to preserve biodiversity and the expectations of those who benefit from it, is a driving force in Solabia's operations.

2.1.1

The steps taken by Solabia to promote biodiversity

Ethnobotany is a new scientific field which straddles the natural and social sciences. Solabia believes strongly in the importance of this discipline for understanding the interdependence between the natural and human worlds.

An Auraucaria tree within the Mata Atlantica forest

EXPANDED COMMITMENTS IN BRAZIL: THE REHABILITATION OF THE MATA ATLANTICA

Since 1995, the company has invested in Brazil with two strategic priorities: to protect the region's biodiversity in partnership with local authorities and NGOs, and to pursue a proactive sustainable development policy. Solabia's factory is located in the State of Paraná, deep in the Mata Atlantica, a forest rich in biodiversity which extends over nearly 4000 km from the north to the south of the region. The history of its commitment to biodiversity can be summed up as follows.

1995 : The first operations involved a species of Araucaria, a tree symbolically associated with the state of Parana, threatened by over-exploitation in the timber industry. The biodiversity characteristic of the Mata Atlantica depends on protecting this species, which is why it is called an umbrella species. An official socio-environmental development programme was established to sustain the relationship between humans and plants.

2005 : In Brazil, Solabia supported an expedition by the CCVS (Conservatoire des Collections végétales spécialisées) sponsored by Truffaut, under an agreement with the Brazilian authorities and in partnership with the Mata Atlantica Biosphere reserve, under the aegis of UNESCO's MAB programme. The goal was to promote knowledge of human practices which encourage good relations between humans and their environment.

2007-2008 : Conversion of mixed forest to Araucaria, in partnership with Brazilian universities. Only the renewable parts of the trees are used. The fallen fruit is gathered by local communities who have developed traditional methods for extracting the various ingredients suitable for the manufacture of cosmetics. In addition, purchasing at least a predefined minimum quantity of the fruit at prices set in advance ensures a base income for the local people.

Seeds of the Araucaria tree, a quintessential species of the Mata Atlantica, used in cosmetics

WHAT ARE THE PLANS FOR THE FUTURE?

- To increase the number of company staff aware of issues of sustainable development and respect for biodiversity, by increasing activities in this direction, especially in internal communications;
- To promote products resulting from this approach to its clients;
- To adapt the Brazilian model to other resources derived from living systems.

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2.1.1

The members of Terr'avenir, farmers in Picardy, Haute-Normandie and Nord-Pas de Calais, have a commitment to the values of the land and their own roots, and share a respect for the environment.

The originality of Terr'avenir's approach resides in its development of an ISO 14001 Environmental Management System which is internationally recognised and monitored annually. Projects can be implemented with the assistance and financial support of the ADEME and the Conseils régionaux of Picardy, Nord-Pas de Calais and Haute-Normandie along with the Agence de l'Eau Seine Normandie.

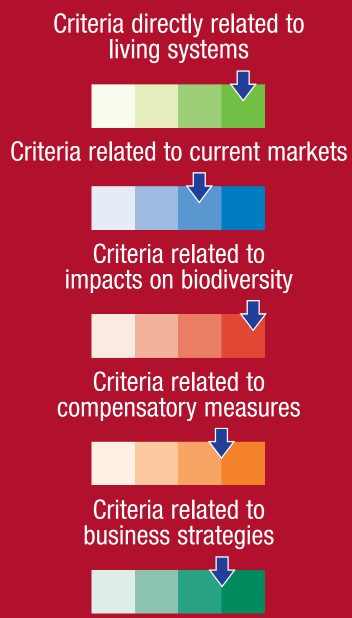
ISO 14001 certification was sought with the goals of
- Reducing the risks and pollution caused by agriculture;
- Strengthening the functioning of its members;
- Following and anticipating legal regulations.

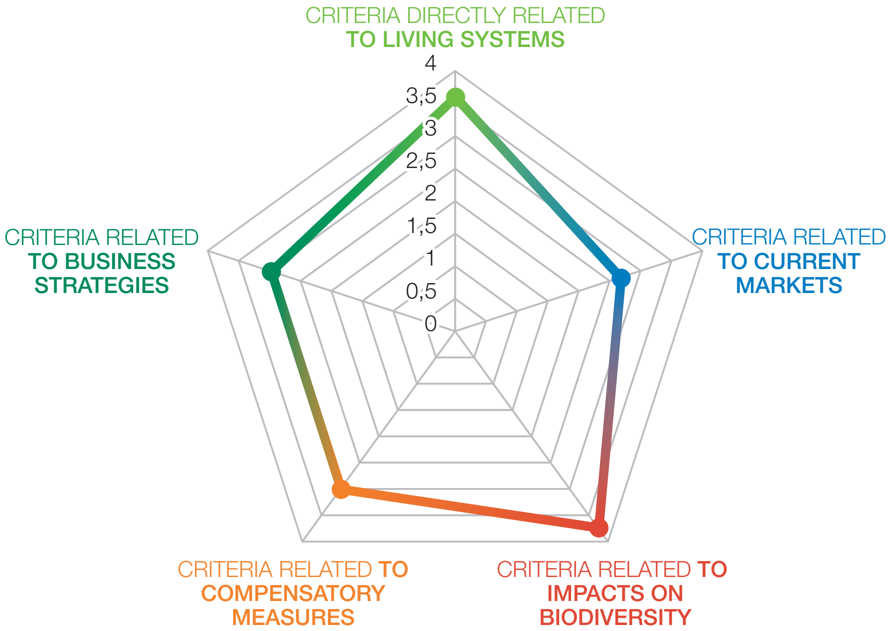
Building on its successes in Picardy, Terr'avenir is expanding steadily:
- Terr'avenir Picardie: 17 ISO 14001-certified farmers and 24 other farms in the process of certification;
- Terr'avenir in Nord-Pas de Calais and Haute-Normandie: 31 and 30 farms respectively in the process of certification.

TERR'AVENIR IN FIGURES

- **103 agricultural enterprises** cultivating almost **25,000 ha**
- **350 people** working for more than **15** arable and animal farms
- **ISO 14001** certification of its farming operations

SELF-ASSESSMENT





> *True pioneers in France, the farmers of Terr'avenir work together for the environment, using an ISO 14001- certified environmental management system.*

THE INTERDEPENDENCE OF TERR'AVENIR WITH BIODIVERSITY

SUMMARY OF THE INTERVIEW WITH *ORÉE* ABOUT THE BUSINESS AND BIODIVERSITY INTERDEPENDENCE INDICATOR

CRITERIA DIRECTLY RELATED TO LIVING SYSTEMS

Dependence on raw materials derived from living systems

Terr'avenir's member farmers are heavily dependent on **raw materials derived from living systems.** The farms, whose size ranges from 60 to 300 hectares, are extremely diverse, in terms of the variety of crops (wheat, corn, apples, diester colza, beet) and of the animal species and breeds. The use of pesticides and of fossil fuel for the operation of machinery indicates their dependence on **living systems of past eras,** although biologically-based amendments produced on their own farms are gradually replacing these.

2.1.1

Dependence on services and technologies from living systems

Farmers and ecosystems are extremely interdependent. The development of agricultural systems relies on the workings of ecological processes which farmers can manage with varying degrees of precision: a number of organisms develop in conjunction with agricultural systems and are thus inseparable from them, such as pollinating insects. Numerous **ecological services** are involved: renewable resources and water, soil conservation and regeneration, nitrogen and carbon fixation by micro-organisms in the soil and by plants, nutrient recycling, flood control and the pollination of crops by insects and birds, an essential service for the reproduction of some plants. To combat pests, some farmers use techniques based on **ecomimetism** instead of using pesticides: for example, phytohormones deceive some insect pests. These environmentally sound practices need to be perpetuated and expanded.

Management of the variability, health and complexity of ecosystems

Among the factors relative to the **variability of ecosystems,** climate unpredictability is often the first to be emphasised by the farmers. Climate phenomena have a significant impact on agricultural production. Seasonal variation, as well as periods of drought or extreme cold, can radically alter growing patterns and the quality of the crops harvested. While these uncertainties can be seen as constraints, the diversity of the land under cultivation, which determines the variety of crops grown, also depends on bio-geo-physical variability within each specific farm or region (climate, soil, elevation). The **health of ecosystems** is therefore a key parameter for farmers, especially as concerns combating pests and controlling effluent. For Terr'avenir, respecting biodiversity requires paying attention to the **complexity of agrosystems,** that is, adopting better growing methods. Nature must be reintroduced as central to farming, in particular the replanting of hedgerows which will encourage the return of biodiversity at a local level.

CRITERIA RELATED TO CURRENT MARKETS

The **costs associated with biodiversity** are generally low (for seeds). With respect to **market positioning,** the ISO certification earned by the organisation provides real added value to its finished products, but is not yet widely recognised as a marker of value in today's market. Lastly, living systems account for the **totality of sales** by the farmers who belong to the organisation, since agriculture means simply the production and sale of living organisms.

CRITERIA RELATED TO IMPACTS ON BIODIVERSITY

Humans have been modifying Europe's natural areas for a very long time: they have **shaped many landscapes,** some of them rich in biodiversity, so thoroughly that the likelihood of the **reversibility of their impacts** is doubtful. Today, the biggest agricultural holdings are controversial because of their large **ecological footprint.** Livestock emit greenhouse gases (methane, eructation), while crops consume fertiliser and pesticides, both of which often find their way into the soil and groundwater. The intensified farming produced by the Green Revolution has contributed massively to the **uniformity of the living world** in rural areas, with the disappearance of smaller fields, reduction in the number of species grown and destruction of hedgerows, grass verges and permanent pastureland. This type of agriculture has contributed to **environmental fragmentation.**

CRITERIA RELATED **TO COMPENSATORY MEASURES**

The principle of cross-compliance was introduced during the reform of the Common Agricultural Policy (CAP) in 1999. It requires farmers to comply with environmental legislation in order to receive financial aid. Terr'avenir's **voluntary commitment** to ISO 14001 standards exemplifies its members' readiness to go beyond regulatory requirements. Both the agronomic strategies implemented (crop rotation) and the techniques employed (use of manure from livestock, adoption of breeds and crop varieties suited to the environment) are designed to manage the impacts of farming. Efforts are being made to reduce field size, replant hedgerows, leave fallow areas for wildlife and reduce the use of additives. In another example, planting cover crops in winter helps prevent nitrogen compounds from polluting the groundwater. Checks are carried out each year on plants and soil to measure the level of potential contaminants. In other words, farmers adapt the ISO 14001 standards in their own way, setting their own goals for reducing the risks and harms of their operation and for **complying with** and **anticipating regulations.**

CRITERIA RELATED **TO BUSINESS STRATEGIES**

Living systems are an **everyday feature** of farmers' lives: they are a source of raw materials and innovation, and are also closely linked to the natural and cultural heritage of the lands farmers care for. **Social pressure** to improve this heritage is growing: the "polluter pays" principle is pervasive in today's discussions, meaning that it is often argued that farmers should pay for the harm they do to the groundwater. For Terr'avenir, the goal is to promote positive interactions between the environment and farm production while still remaining **competitive. Communication** about best practices and eco-responsible land management becomes a high priority: this is the important role the organisation fulfils for its members. However, it is impossible to overestimate the obstacles thrown up by a regulatory framework that is often rigid and ill-adapted. For example, the organisation's members would like to expand the practice of spreading manure from their own farms on their fields, thus moving towards environmental self-sufficiency. However, authorisation to do this is very hard to come by. In this same context, it is difficult to preserve biodiversity in the fields both with respect to the choice of crops to be grown and also the other species dependent on agrosystems, and then to find viable **business opportunities** given the extra costs incurred. Joint efforts are called for, not only at the producer level but also by the suppliers, distributors and consumers.

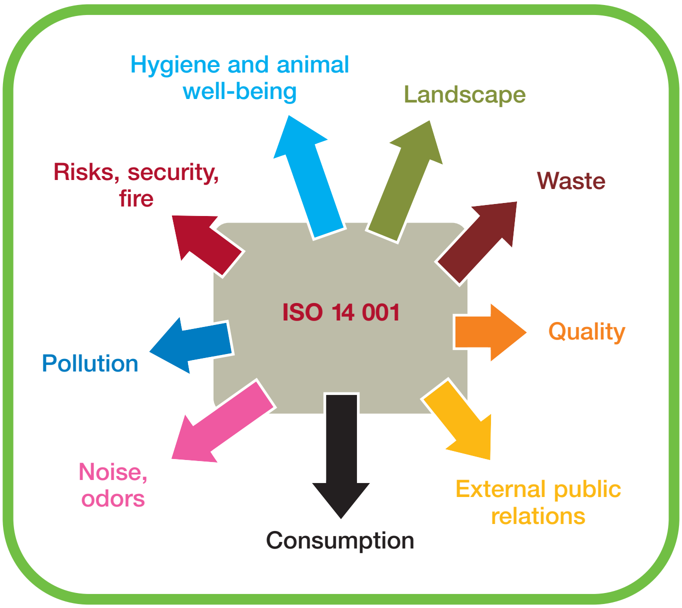
2.1.1

The steps taken by Terr'avenir to promote biodiversity

Complying with ISO 14001 standards for Terr'avenir's farmers requires an overall evaluation of the operations conducted on each farm, the identification of the resulting impacts on the environment and the establishment of a plan for improvement. Although Terr'avenir's approach focuses rather on reducing the direct impacts of agriculture, it is moving gradually towards a more comprehensive evaluation of living systems on the farms.

PROTECTING BIODIVERSITY MEANS FIRST OF ALL REDUCING THE IMPACTS OF AGRICULTURAL OPERATIONS ON FARMLAND ECOSYSTEMS

- Reduction of all environmental risks
- Control of water consumption in irrigation
- Waste management
- Reduction of consumption of fuel oil
- Organic fertiliser
- Reducing of chemical additives
- Planting of hedgerows to reduce erosion, filter water and encourage biodiversity



THE REDUCTION OF CHEMICAL ADDITIVES AS A PRIMARY GOAL

Reducing the amount of chemical additives, both pesticides and fertilisers, is a primary goal for agriculture. Terr'avenir has made a material contribution here to crop farming using alternative methods, such as mechanical weeding, which have reduced the amount of additives by up to 50%.

GOALS	METHODS
Reduction of pesticides • **Potato blight** • **Insecticides**	 • Using Mildilis to combat potato blight: 20% less use of pesticides • Systematic counting of insects before treatment
Reduction of fuel consumption	• 50% of motorised field work performed in a single pass
Reduction of the impact of fertilisation	• Analysis of nitrogen balances: in 2005, a 50% reduction in phosphate fertilisers and more than 30% reduction in nitrogen fertilisers • Use of by-products (biomass • Systematic planting of intermediary crops to trap nitrates after cereal crop harvesting: 900 ha in 2005 • Using the Jubil method for wheat and adjusting fertilisation amounts: reduction in amount of nitrogen used
Raising awareness of risks	• Training employees in security, procedures, environment
Improving waste processing and storage	• Analysis aimed at reducing waste generation and improved recycling • Decision to stop burning plastic sheeting
Encouraging wildlife	• Planting hedgerows • Splitting up fields

2.1.1



Planting hedges for biodiversity

Splitting up fields and planting hedgerows

Several steps have been taken in this direction, with the support of the Direction Départementale de l'Agriculture and the Chambre Régionale d'Agriculture in Picardy. Fields covering 30 hectares have been divided into a larger number of fields measuring no more than 12 hectares, separated by grass verges which are particularly attractive to local wildlife. The signing of a contract with the Somme hunting federation, establishing fallow areas for wildlife, marks a commitment to the preservation of wildlife which is often seen as harmful in the world of agriculture. And in 2004 1300 shrubs were planted to create hedgerows.

What are the plans for the future?

Terr'avenir's approach is an innovative one in the farming world. The obstacles to the expansion of its operations are still numerous and often due to French and European regulations which are not easy to alter. At present, complying with ISO 14001 standards requires the members of Terr'avenir to devote a considerable amount of time to establishing and monitoring indicators and dealing with red tape. While ISO 14001 is still struggling to be recognised as legitimate in the face of the intensive farming which is thoroughly integrated into the present system, some recent distinctions (the Business and Environment Prize in 2007) testify to the hard work of Terr'avenir farmers, pioneers in eco-friendly farming.

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2.1.1

Founded in Lyon in 1853 as the Compagnie générale des eaux, the company was renamed Vivendi in 1998 before becoming Veolia Environnement in 2003. It comprises four divisions:

- Veolia Eau
- Veolia Propreté
- Veolia Energie - Dalkia
- Veolia Transport

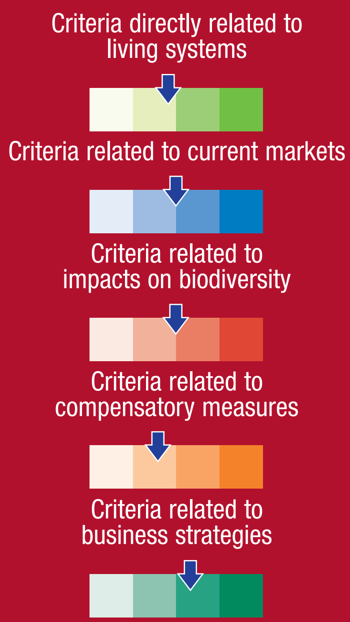
Veolia Environnement offers a wide range of environment-related services focused on four strategic areas: water (drinking water, sanitation, engineering, infrastructure), environmental services (collection, sorting, storage, waste recycling), energy (heating and cooling systems, public lighting, maintenance and installation of equipment) and the transport of goods and passengers.

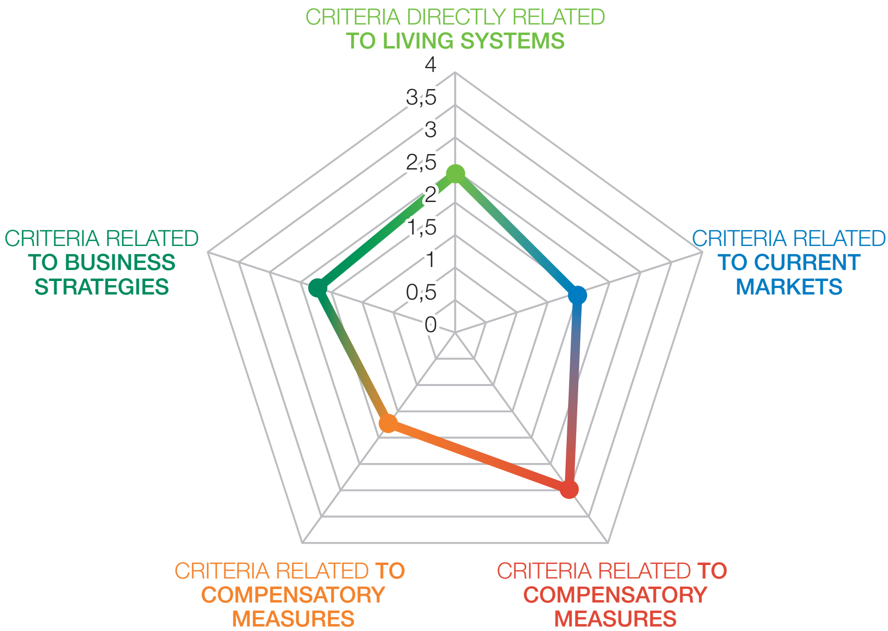
Through its various operations both in France and abroad, Veolia Environnement manages its interactions with ecosystems by identifying the impacts of its activities and incorporating biodiversity into the core of its Environmental Management System.

VEOLIA ENVIRONNEMENT IN FIGURES

- 2007 sales of **33 billion** €
- **N° 1** worldwide water services provider and N° **2** environmental services provider
- **N° 1** private train operator on the French rail network
- **319,502** employees worldwide
- **118 M €** research budget , with **800** experts and more than **100** pilot projects

SELF-ASSESSMENT





> *Veolia Environnement has been at work on biodiversity issues since 2004 and now seeks to introduce a more structured approach into its facilities.*

THE INTERDEPENDENCE OF VEOLIA ENVIRONNEMENT WITH BIODIVERSITY

SUMMARY OF THE INTERVIEW WITH *ORÉE* ABOUT THE BUSINESS AND BIODIVERSITY INTERDEPENDENCE INDICATOR

CRITERIA DIRECTLY RELATED **TO LIVING SYSTEMS**

Dependence on raw materials derived from living systems

The four divisions of Veolia Environnement are dependent on **natural raw materials** in ways that vary considerably in keeping with their different activities. Veolia Eau uses large quantities of bacterial biomass for sewage treatment, as does Veolia Propreté for the storage and composting of waste. This type of dependence is less significant for Dalkia, with 97 of its facilities exploiting biomass energy. It is non-existent in the case of Veolia Transport. However, for all the divisions, dependence on **fossil fuels** is extensive, especially in the case of Veolia Energie - Dalkia for its heating system operations.

2.1.1

Dependence on services and technologies from living systems

The degree of dependence on **ecological services** is not always easy to assess. It concerns mainly the use of biomass (provisioning services) and eliminating water pollution (autonomous water purification service; the use of micro-organisms is akin to a form of biotechnology). Although water purification and waste treatment are designed to fit in with biogeochemical cycles, the many uncertainties and absence of standardised methods make it difficult to identify specific relationships between ecosystem services and the development of the company's operations. Examples of **biomimetism** can be found in many contexts, even though these are not always recognised as such by Veolia's employees: the reuse of farming waste by composting borrows from the natural recycling processes of organic matter and can be extended to the use of sludge from sewage treatment plants, plant waste and household rubbish. The composting treatments employed by Veolia Propreté not only help to get rid of a considerable amount of organic matter which would otherwise have to be buried in landfills, but also improve the return of organic matter to the soil (enrichment), which in turn fits in with the biogeochemical cycles.

Management of the variability, health and complexity of ecosystems

Changes in weather patterns can affect the demand for water and energy. Changes in the **biophysical and chemical parameters** of ecosystems occasionally generate extra costs, such as the controlling of algal blooms for Veolia Eau. **Water quality** is monitored closely by this division, which needs in-depth

A technician collects a sample in the wild for subsequent analysis, France

knowledge of the ecosystems within its purview in order to propose appropriate treatment measures. The more degraded an environment has become, the more indispensable is Veolia's expertise. Processing operations must balance quantity and quality, controlling outflows which can be massive and also managing residual impacts on the environment. A number of **complex ecological processes** take place in the soil and water: these are real opportunities for R&D to come up with processes and instruments which will benefit the ecosystems.

CRITERIA RELATED TO CURRENT MARKETS

Although the company's **sales figures** are not directly related to biodiversity, sewage and wastewater treatment operations are related partly to the processing of organic materials. Apart from the relatively low cost of recapturing biomass energy, and fossil fuel costs which have risen sharply in recent years, the work done by bacteria in sewage and wastewater treatment is 'free'. Moreover, many organisms develop in tandem with the operations of Veolia Eau and Veolia Propreté, particularly bird species which make use of sewage treatment facilities. At the moment, biodiversity as such does not constitute a **marketing advantage.** However, the changing expectations of clients (public tenders), who are coming to accord greater importance to biodiversity in towns and cities and in the management of bodies of water, may alter the situation.

Wastewater treatment plant in Bolivar, benefiting from a replanting programme in the surrounding forest area, Adelaide, Australia

CRITERIA RELATED TO IMPACTS ON BIODIVERSITY

As most of the company's physical assets are long-term facilities such as factories and storage centres, which sometimes **alter the landscape significantly,** integrating these facilities into the surrounding environment is a pressing concern for its corporate culture. By reducing **pollution levels** in the environment, Veolia Environnement contributes positively to ecosystem health and the quality of life of its customers. At the same time, some of its operations require the management of secondary impacts on ecosystems, such as the **residual pollution** and **greenhouse gas emissions** produced by its transport equipment. Assessing these impacts on **species distribution** and **habitat fragmentation** is now a focus of serious attention, including the setting up of an information system which identifies the geographical locations of its major facilities in relation to areas of ecological interest.

CRITERIA RELATED TO COMPENSATORY MEASURES

Compensatory measures, whether **obligatory** or **voluntary,** depending on the legislation in force in each country, affect only those facilities occupying large tracts of land sited in rural or minimally urbanised areas (waste storage centres). Experience with these measures is recent and difficult to characterise overall, given the size and international reach of the company. Through its **foundation,** Veolia funds many environmental projects in France and abroad. A new programme has been launched to support sustainable development in the Bay of Haiphong in Vietnam, designed to preserve the biodiversity of the Red River estuary and enable further development of fisheries, aquaculture and tourism.

2.1.1

CRITERIA RELATED **TO BUSINESS STRATEGIES**

While the use of living systems is essential to the processing operations of Veolia Eau and Veolia Propreté, measuring the impact of its physical installations and operations on biodiversity is a **challenge** that the company has been attempting to respond to since 2004. Its public image is in part dependent on this, especially given the **pressure from stakeholders** calling for action in the face of the increasing erosion of natural diversity world-wide. The company is working with various academic and institutional partners to expand its knowledge and improve its practices via research programs focused on the interactions between its operations and the functioning of ecosystems. Biodiversity is not only seen as a negative. Although taking it into account generates extra costs in the short term, investing in it could lead to **increased competitiveness** over the medium to long term in developing markets. This is also relevant to **new services,** as in the case of the 2007 acquisition of Organica, a company which treats effluent via the use of plants. Internally, the environmental performance department is seeking to identify a group of best practices based on questionnaires administered to the employees. This contributes to making biodiversity a fully-fledged element in the development of a corporate culture based on sustainable development.

The steps taken by Veolia Environnement to promote biodiversity

All the company's operations are bound up with the preservation of biodiversity:

1. Veolia Environnement seeks to integrate the protection of biodiversity into the land occupied by its facilities, starting with the initial design of its projects, via a sustainable development approach.
2. While the company's various operations help to reduce the level of pollution which affects ecosystems, the secondary impacts which it is responsible for managing and reducing are also taken into account - the residual pollution in waste materials and the consumption of natural resources.

THE IDENTIFICATION OF ECOLOGICAL IMPACTS AND THE MANAGEMENT OF BIODIVERSITY ON LAND OCCUPIED BY THE COMPANY

To complement traditional physico-chemical and bacteriological methods, Veolia Environnement has built up extensive expertise in the use of new methods for measuring the waste it releases into aquatic environments, the atmospheric emissions it generates and its own products (organic amendments and secondary raw materials). Predictive eco-toxicity tests are complemented by biological tools, indicators of the healthy condition of water and land environments. The company works with many partners in academia and other institutions in order to access the most advanced expertise, particularly in ecosystem modelling, a field which provides a clearer understanding of ecosystems' complexity and forecasts how they will change over time.

In parallel, a Geographic Information System (GIS) identifies the locations of its major facilities in relation to areas of ecological interest and specifies their global positioning co-ordinates. The gradual integration of this tool with the environmental information system used for environmental reporting and audits will make it more widely usable by Veolia employees. The company is also developing a method for systematic evaluation of the impact on biodiversity of its major facilities. This will make the local characteristics of the natural environment into an integral part of the design and management of the site, in preparation for an appropriate action plan. The results will be measured by selected monitoring indicators.

THE COMMITMENT MADE BY VEOLIA EAU

Biodiversity has become a major issue for Veolia Eau in recent years. The idea is to ensure the provision of high-quality drinking water and sanitation while also making a commitment to protecting living systems. Taking account of all the elements of the water cycle and the interactions between natural systems and human systems is essential. The preservation and improvement of ecological standards becomes an index of environmental performance.
In response to this need, Veolia Eau plans to:

- Promote integrated management of the water cycle and of ecosystems, in order to achieve a proper balance between the use and the protection of this resource;
- Support communities faced with new challenges, by helping them meet the goal of the Water Framework Directive, that is, to restore ecological standards of water resources by 2015, and by participating in the protection of wetlands, including areas of international significance;
- Make local communities and individuals central to the projects once more: in the knowledge that the preservation of biodiversity is a subject of general interest, Veolia Eau is committed to fostering dialogue and collaboration between consumers, farmers, associations of local inhabitants and nature conservation groups, local and national governments.

Today Veolia Eau offers a range of services to its customers, local communities and industry, designed to meet the challenge of preserving biodiversity: (a) research and consulting (impact studies, requirements for the development and management of sites), (b) project supervision and management for the installation of surveillance networks for aquatic environments as well as restoration operations, (c) the organisation of outreach initiatives relating to the protection of the environment and of biodiversity.

The ecologically sound management of a subcontracted area: the example of Crépieux-Charmy (France)

The sustainability of the Crépieux-Charmy abstraction zone, which provides drinking water for almost all of greater Lyon, is a crucial issue for the city's population. Lying to the west of the city of Lyon, it forms the largest abstraction zone in Europe (375 hectares), and is also designated as a Natural Area of Ecological, Plant and Animal Interest, a Sensitive Natural Area, a Unique Wetland and a Natura 2000 site.

2.1.1

It is in this context that Veolia Eau has been operating the site since 1987 for the supply of drinking water to greater Lyon

The Crépieux-Charmy abstraction zone and the infiltration basins for aquifer replenishment located in the centre of Lyon, France

With a view to preserving and expanding the site's unique ecological heritage, Veolia Eau has joined the Lyon Urban Community and local nature conservation organisations to pursue the monitoring, restoration and maintenance of the ecological heritage as part of a five-year plan for the management of the site. These operations are the focus of dialogue with various partners and are accompanied by consciousness-raising and public relations initiatives with local groups and young people.

A team of five people responsible for the care and maintenance of the site is in charge of monitoring its ecology, with regular input from experts from local nature conservation organisations (FRAPNA, CORA). The team draws up animal and plant inventories and enriches the scientific knowledge of the site. It also maintains and manages various habitats: it creates and modifies ponds for amphibians, restores areas of bushes and shrubs for nesting birds and mows the meadowlands each autumn with a limited level of maintenance around the drainage wells.

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2.1.1

Yves Rocher is a cosmetics company founded by Yves Rocher at La Gacilly in Brittany. It is the core of a group of companies with nearly 15,000 employees in all, working for one of the eight brands: Yves Rocher, Stanhome, Kiotis, Petit Bateau, Dr. Pierre Ricaud, Isabel Derroisné, Daniel Jouvance and Galérie Noémie.

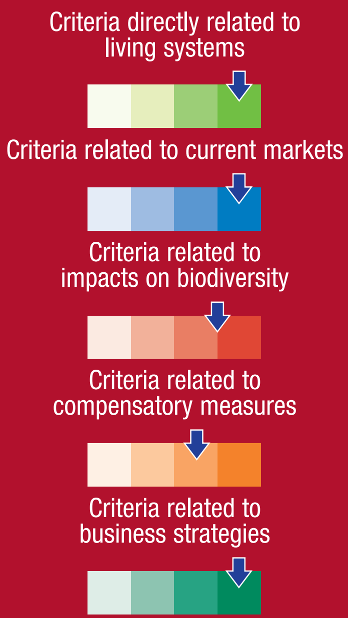
A sense of responsibility for the environment has always been a feature of the company, which focuses on the development of plant-based products. Respect for nature is an ongoing personal commitment for each employee, and the company's pioneering spirit is demonstrated by a first: ISO 14001 certification for cosmetics. This commitment is supported by the Fondation Yves Rocher-Institut de France through educational programmes which seek to strengthen the relationship between humans and nature.

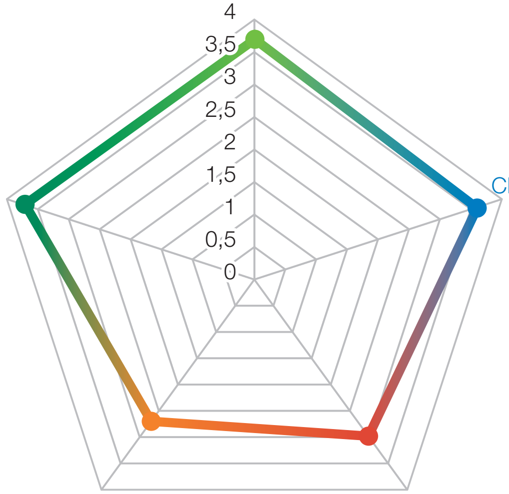
Beyond these general considerations, the group and the brand have developed specific plans in the realm of biodiversity, with several operations under way.

YVES ROCHER IN FIGURES

- **1.3 billion** €in sales of which **50%** is mail-order
- More than **8000** employees worldwide
- Inventor of Cosmétique Végétale®
- Grower, manufacturer and distributor: **44 ha** organically farmed, **5** factories, **1,500** shops and **30** million customers in **80** countries

SELF-ASSESSMENT





> *"From the plants it uses to the customers it serves, Yves Rocher has adopted a proactively eco-friendly attitude."*

THE INTERDEPENDENCE OF YVES ROCHER WITH BIODIVERSITY

SUMMARY OF THE INTERVIEW WITH *ORÉE* ABOUT THE BUSINESS AND BIODIVERSITY INTERDEPENDENCE INDICATOR

CRITERIA DIRECTLY RELATED TO LIVING SYSTEMS

Dependence on raw materials derived from living systems

For its cosmetics made from essential oils, active ingredients derived from plants and paper for internal or business use, Yves Rocher depends heavily on **raw materials derived from living systems.** With its original base in Brittany and extensive international development, consumption of **fossil fuels** for transport and packaging is also extensive.

2.1.1

Dependence on services and technologies from living systems

The cultivation, watering and harvesting of plants are examples of dependence on **provisioning services.** The company takes these into account by reducing its consumption of materials to ensure the continuance of its operations. In 1997 conventional cultivation at La Gacilly was replaced by organic farming, resulting in better care of the ecosystems and ecological services from which the company benefits. **Biomimetism** is another interesting concept which is primarily applied to the identification of the properties of plants and their use in cosmetics production.

At La Gacilly, Brittany, the Yves Rocher company cultivates 44 hectares of plants grown organically

Management of the variability, health and complexity of ecosystems

Flowering cycles, seasonal variation and the quality of the materials grown are all parameters which affect the planning and management of production processes. Yves Rocher believes that **healthy ecosystems** are the essential basis for ensuring the sustainability of plant biomass and the quality of the active ingredients. Soil and water quality and the preservation of the resources on which it draws all help determine the company's success. The company's R&D division, which follows recognised quality procedures, is a major resource for dealing with the **complexity of ecosystems.** For example, in the case of organic farming special attention may be paid to pest invasions which threaten the crops.

CRITERIA RELATED TO CURRENT MARKETS

Raw materials from **living systems** form a significant part of the **cost** of finished products. The company has to deal with price fluctuations on the agricultural market. Yves Rocher, inventor of the Cosmétique Végétale®, has identified five basic principles for its **market positioning:** among them are the guiding importance of the plant world, the use of all the riches of the plant world and the proactive preservation of the environment. This is why the overwhelming majority of its products are based on natural active ingredients: biodiversity underpins the company's **sales figures.**

CRITERIA RELATED TO IMPACTS ON BIODIVERSITY

The company attaches great importance to constructing its facilities without **altering the surrounding landscapes.** The Gâtinais site at La Gacilly was designed to preserve a deep-cut woodland path, a typically Breton landscape feature. Ethnobotany is considered each time a new construction is planned, so as **to use local species** for the landscaping. Organic farming, especially horticulture, helps to keep a rural landscape alive around the perimeter of the village. The manufacturing sites do not generate much **waste,** and have been engaged for several years in the ISO 14001 certification process. To minimise **impacts on species,** all sourcing of plant-based ingredients has been subjected since 2006 to the 'Plant Charter' which prohibits the use of plants listed by CITES and of genetically modified varieties. The Charter prioritises cultivation over the gathering of wild plants, and promotes the use of the renewable parts of plants as well as responsible growing methods. Scientific research has, for example, led to the protection of *Arnica montana* in Germany, which has since been replaced by *Arnica chamissonis* grown at La Gacilly. Lastly, the company's impact on **landscape fragmentation** is indirect, since the areas used for growing flowers are not very extensive. It is primarily our suppliers who are involved in habitat fragmentation.

CRITERIA RELATED TO COMPENSATORY MEASURES

While the company complies with the regulations applying to Installations Classées Pour l'Environnement (ICPE), no **compensatory measures** have been needed thus far. However, **voluntary protection initiatives** are regularly introduced. Yves Rocher and its partner Serdex (Bayer HealthCare division) have implemented the sustainable sourcing of *Aphloïa theiformis.* A small-to-medium business in Madagascar, Sotramex, is in charge of the non-destructive gathering, drying and quality control of its leaves. As a complementary source of income for local people, gathering *aphloïa* leaves constitutes an encouragement to renounce slash-and-burn farming, one of the main causes of the massive deforestation that endangers the biodiversity of an island with a particularly high proportion of native species. Now that the quantity of leaves purchased is increasing, the cultivation of *aphloïa* is being introduced with the help of an NGO, Fanamby. The

Ethnobotany research trips are regularly organised by the Yves Rocher company to select the best plants

projects funded by the Fondation Yves Rocher-Institut de France also demonstrate the company's commitment in the form of education, consciousness-raising and conservation projects.

CRITERIA RELATED TO BUSINESS STRATEGIES

Plants form the source of inspiration for Yves Rocher, whose **brand image** is based on its "natural" positioning. To ensure the **continued availability of its products,** optimisation of resource management and waste reduction are major challenges. The company **communicates** its commitments to the general public and to its customers via the various types of media (mailings, catalogues, store advertising), but also via the Fondation Yves Rocher-Institut de France. Biodiversity is the **raw material of the R&D teams.** Environmental challenges can prompt **in-house group activities,** such as the showing of the Al Gore film "An Inconvenient Truth" on World Environment Day. While in the past it was primarily oriented towards the plant world, today the company's discussions and operations are opening up to other aspects of biodiversity.

2.1.1

The steps taken by Yves Rocher to promote biodiversity

Since plant biodiversity accounts for its primary raw material, Yves Rocher is developing responsible practices throughout its operations, from research, cultivation, design and production up to product marketing.

FOCUSING ON EDUCATION

Yves Rocher has also taken on the goal of communicating its admiration for nature's wonders and its commitment to the living world to its customers world-wide. The Végétarium, opened in 1998, is the first European museum completely dedicated to the plant kingdom; the National Museum of Natural History contributes to the wealth of its holdings, which are constantly expanding.

The Fondation Yves Rocher-Institut de France helps to raise the consciousness of different audiences through education, protection and eco-awareness projects:

1. The "Terre de Femmes" prize, awarded in 11 countries across Europe since 2001, rewards women active in non-profit conservation organisations. In 2008, it was awarded to Sylvie Monier, who is active in hedgerow restoration in the Auvergne.
2. A year-long awareness programme for children has also been developed: for example, each year the Fête de la Nature brings together 800 children from local schools in La Gacilly.

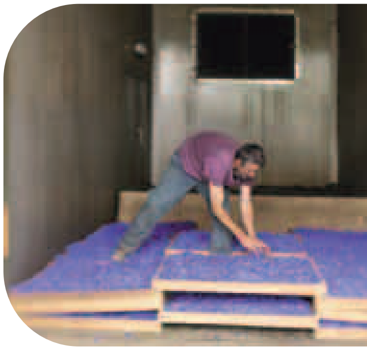
Encouraging small everyday actions also matters. That is why many product packages enclose a suggestion for a 'green' action to encourage users to reduce their impact, for example limiting the number of cotton pads used for makeup removal.

World Environment Day is also celebrated at all the company's locations. Since 1991, these "Green Days" have provided an opportunity for education, awareness and group activity projects for the employees. In 2008, the theme of "Marvellous Nature" gave everyone a chance to recognise the value of the services provided by nature which enable the group to carry out its various operations successfully.
This willingness to act and to motivate others was naturally fulfilled by the company's involvement with the United Nations Environment Programme, in the "Plant for the Planet: Billion Tree Campaign". Combining its own commitments with those of its employees, customers and suppliers, Yves Rocher has taken on the goal of planting one million trees over three years in Madagascar, India and Brazil.
These operations, whose impact is not always measurable, testify to the company's readiness to promote every kind of eco-friendly approach.

CHOOSING RESPONSIBLE SOURCING: ORGANIC FARMING AT LA GACILLY

Sourcing of raw materials happens mainly in developing countries. With respect to gathering in the wild, Yves Rocher insists on absolute respect for best practices which do not deplete plant stocks and on raw materials of impeccable quality.

To reduce the amount of materials gathered in the wild, Yves Rocher relies on an increasing volume of organically grown plants - because of the good farming practices this requires, not merely as a marketing ploy. The promotion of organic farming for the selection of its extracts is one of the highlights of the "Plant Charter". This calls for farming techniques based on the recycling of natural organic materials to maintain the balance of living organisms in the soil. It also means banning the use of synthetic chemicals such as pesticides, herbicides and fertilisers, and of any genetically modified life-forms.



Drying the plants, one of the first stages in the manufacture of active ingredients

Since 1997 Yves Rocher has devoted 44 hectares of land to organic farming at La Gacilly in Brittany. Today, organic farming accounts for about one-third of the plants sourced. For example, camomile used for the "Pure Calmille" range of beauty products is grown in organically certified fields in Brittany. The company has made a commitment to doubling the area under organic cultivation by 2010.

Products based on plant extracts resulting from organic farming

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2.1.2 Local governments

92
Conseil général des Hauts-de-Seine

The Conseil général of Hauts-de-Seine has been committed for many years to promoting the balanced and sustainable development of its jurisdiction. Its highest priority is the preservation of the environment, in conjunction with the digital revolution, the renewal of La Défense and the creation of a "valley of culture" along the Seine.

The various components of this top-priority policy enable us to maintain our position at the intersection of economic, urban, cultural and environmental concerns.

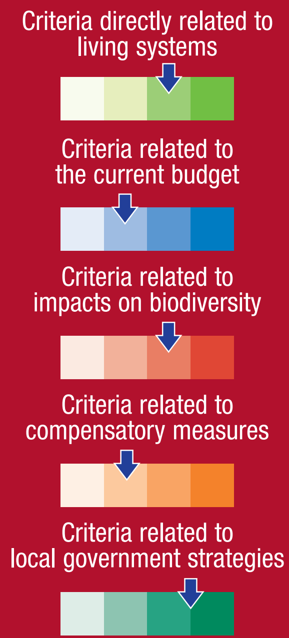
In 2007, the "Grenelle de l'Environnement" brought to the fore the question of how to live better by balancing the environment and the economy.

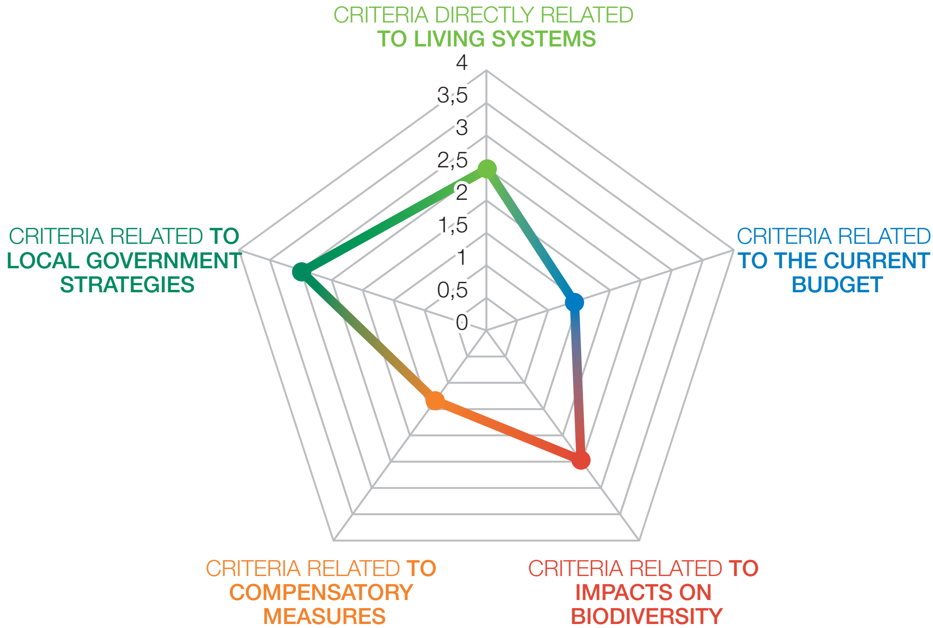
Environmental initiatives focus on the preservation of sensitive natural areas, the installation of a "green corridor" within the department and the return of the River Seine to the local residents. The Conseil général of Hauts-de-Seine has been expanding its own knowledge of the open spaces and biodiversity of the department since 1995. Agenda 21, recently introduced, has stimulated in-depth discussion of biodiversity issues and focuses on drawing up a cross-cutting strategy which will incorporate the diversity of living systems into departmental planning.

THE CONSEIL GÉNÉRAL OF HAUTS-DE-SEINE IN FIGURES

- **36** communes and **45** cantons over an area of 176 km^2
- **1,517,000** inhabitants, population density **8,620** inhabitants per km^2
- **7,830** hectares of green space
- **67 km** of riverbank along the Seine

SELF-ASSESSMENT





"The Conseil général of Hauts-de-Seine has made a commitment to biodiversity via targeted management of its green spaces."

THE INTERDEPENDENCE OF THE CONSEIL GÉNÉRAL OF HAUTS-DE-SEINE WITH BIODIVERSITY

SUMMARY OF THE INTERVIEW WITH *ORÉE* ABOUT THE LOCAL GOVERNMENT AND BIODIVERSITY INTERDEPENDENCE INDICATOR

CRITERIA DIRECTLY RELATED **TO LIVING SYSTEMS**

Dependence on raw materials derived from living systems

Substantial amounts of **resources derived from living systems** are produced and consumed each day within the department. The Conseil général is directly responsible for the consumption of paper, wood, and plants for green spaces and food for school canteens. The heating of buildings and the fuel for road maintenance equipment are examples of the authority's dependence on fossil resources from **living systems of past eras.**

2.1.2

Dependence on services and technologies from living systems

The inhabitants of Hauts-de-Seine benefit from numerous ecological services on a daily basis. **Provisioning services** (foodstuffs, water), **support services** (oxygen) and **regulatory services** (climate regulation, control of invasive species and diseases, pollination) have an effect on the evolution of the department. Beyond consideration of the ecological services the inhabitants receive, it is important to view urban and suburban spaces in a new way, and to invest in sustainable ecological continuities. With respect to the targeted management of green spaces, in addition to providing the normal habitats for biodiversity, the Conseil général is developing practices based on **biomimetism.** This includes the introducing sheep to maintain meadowlands, controlling disease through the use of auxiliary insects and recycling biomass waste. Composting helps maintain soil quality.

Targeted management in the Parc de Sceaux: a flock of sheep is an alternative to mechanical mowing

Management of the variability, health and complexity of ecosystems

Unpredictable ecosystem change in towns and cities affects many things, including temperature and rainfall. It directly influences area planning policy and construction standards. The **health** of the **urban ecosystem** is crucial, but managing it often involves factors beyond the department's control, such as the quality of the drinking water. This criterion is associated with the additional costs of managing public spaces, including control of invasive species or pollution remediation. There is a close link between urban areas and artificial ecosystems: **replacing ecological processes with artificial mechanisms** such as water purification plants, or canalising waterways, has a significant environmental impact. During storms, uncontrolled discharges of polluted water affect aquatic organisms such as fish, thus generating additional costs for the local government.

CRITERIA RELATED **TO THE CURRENT BUDGET**

Only a few costs are directly **related to biodiversity,** apart from minor purchases of raw materials: the ecosystem services which the department, its inhabitants and businesses benefit from are in effect free of charge. The costs are mainly associated with wages and regular operating expenses. **The budget line item for biodiversity** covers the management of green spaces, and ten percent of the technical services staff is assigned to it. The school canteens now offer an organically grown meal once a week. This measure will soon be expanded to more days each week, enabling the department's children to consume differently. The goal is to make Hauts-de-Seine an **attractive department** with respect to biodiversity.

CRITERIA RELATED **TO IMPACTS ON BIODIVERSITY**

Like the rest of the outskirts of Paris, Hauts-de-Seine is **highly urbanised.** The environmental challenges are many, and concern the Conseil général both directly and indirectly: **wastewater treatment,** heating and insulation of buildings, public transport and waste disposal. Although the urban fabric is very dense, the role of the Conseil général in urban policy is relatively limited, mainly via its participation in the financing of new infrastructures and the upkeep of public spaces. The institution of an active policy for sensitive natural areas and efforts to reduce the impact of outdoor advertising are two examples of its intervention. Furthermore, **habitat fragmentation** is the main cause of the degradation of biodiversity throughout the department, due to the draining of wetlands, road building and soil disturbance. The maintenance and restoration of an **ecological continuum** connecting areas of biodiversity is a major challenge. Efforts to eradicate **invasive species,** such as the Korean squirrel or Florida turtle, are implemented alongside the efforts undertaken to reduce pressure on the diversity of habitats and **distribution of species.**

CRITERIA RELATED **TO COMPENSATORY MEASURES**

Compensatory measures are not directly related to the property assets of the Conseil général. By contrast, regulatory compensation may be required following new developments or construction financed by the department. This is relatively minor in a department that is already heavily urbanised. Numerous voluntary operations are carried on in connection with the protection of biodiversity, including environmental inventories, green space conservation management measures and action plans for establishing ecological corridors. Others are budgeted, including the management of wild areas, in support of organisations such as the ONF which are in charge of areas rich in biodiversity.

CRITERIA RELATED **TO LOCAL GOVERNMENT STRATEGIES**

It is crucial that all stakeholders acknowledge the importance of the fabric of the living world if biodiversity is to be preserved at department levels. In Hauts-de-Seine, major efforts have been undertaken in the last three years to preserve pre-existing biodiversity. Although the budget and staffing allocated to it are relatively low, the Conseil général seeks to assign particular importance to “ordinary biodiversity” in the towns, as a key ingredient for the improvement of local **quality of life.** In this connection, the development of a department-wide strategy, through a long process of consultation, has generated commitment and interest among **all stakeholders,** including non-profit organisations, government agencies and businesses. New initiatives will soon see the light of day: for example, **awareness and education programmes** for public officials, businesses and residents will develop, disseminate and generalise good practices. Publicising biodiversity issues has a key role in enhancing the department’s appeal.

An example of biological control: pheromone traps to combat the horse-chestnut leaf miner

2.1.2

The steps taken by the Conseil Général of Hauts-de-Seine to promote biodiversity

Biodiversity began to be an active concern in 1994, with a targeted management approach in which hay meadows were planted in some areas of the department's public parks, on an experimental basis. It was with the development of policies for sensitive natural areas, starting in 1999, that the issue really became significant.

Thus far, operations to promote biodiversity have been carried out on 80% of the sensitive natural areas. These include land acquisition, research studies, new developments and maintenance work needed to preserve local plants and animals.

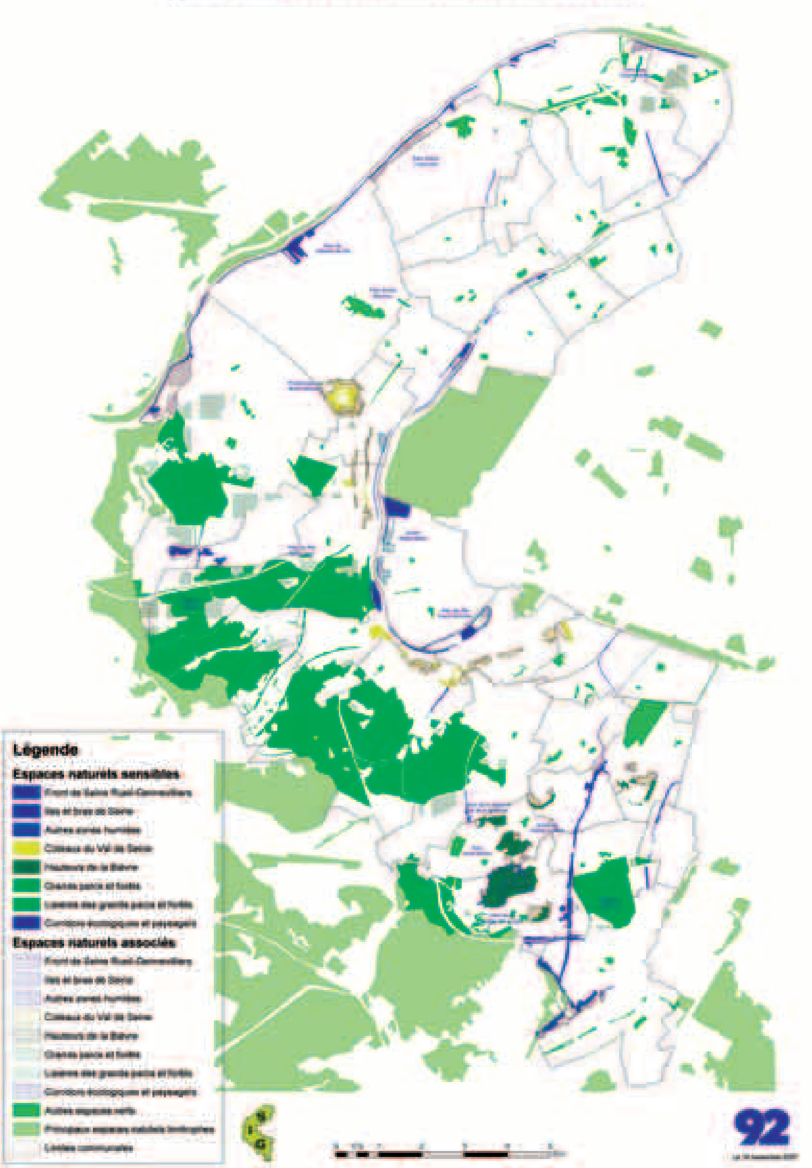
PROTECTING SENSITIVE NATURAL AREAS IN HAUTS-DE-SEINE

The departmental planning document for sensitive natural areas, approved in April 2001, is the result of two years' consultation with all stakeholders (national, regional, other departments, municipalities, public institutions and non-profit organisations). This document lists all the natural areas and prioritises the conservation activities for each one. The need to balance extensive urbanisation with the ecological management of the natural areas in the department has led to the identification of the following goals:

- Promoting biodiversity in the major parks and forests;
- Connecting the major natural areas together, ecologically and physically;
- Improving the natural use of islands and preserving the last remaining natural riverbanks between Asnières and Issy-les-Moulineaux;
- Preserving the continuity of the landscape on the hillsides above the rivers Seine and Bièvre;
- Preserving the wetlands of the Bièvre and the Godets;
- Preserving the ecological and landscape diversity of the heights of the Bièvre.

Several projects have been undertaken: the creation of an urban natural park, adopting the approach of the regional natural parks, covering 850 hectares of ecological and landscape importance in the towns of Rueil-Malmaison, Garches and Vaucresson, and the drafting of a project for the development of a public way across the hillsides and parks in the Val-de-Seine, including the communes of Sevres, Meudon and Issy-les-Moulineaux.

Green space in the department of Hauts-de-Seine



2.1.2

CREATING A NETWORK OF ECOLOGICAL CONTINUITIES THROUGHOUT THE DEPARTMENT

To ensure ecological and physical continuities, projects to link the major natural areas together have been investigated. The ecological continuity between the forest of Meudon and the forest of Fausses-Reposes is beginning to take shape. This link is composed of long narrow tracts of land strategically located between the two major features in the southern part of the department: on the one hand, the forest of Meudon with its 1,080 ha listed in the ZNIEFF inventory (as a natural area of ecological, plant and animal interest), and on the other the heights of the Bièvre, including the woodlands of Solitude and the Garenne and the Henri Sellier and Vallée-aux-Loups parks. It is now possible to restore the continuity of the natural areas between the woodlands through the acquisition of plots of land, either by eminent domain or landowner agreement, the creation of a path and the planting of freely growing vegetation (hedges and groves of trees). On the same model, many sites outside the sensitive natural areas will in due course be incorporated into a network of natural areas throughout the department, in conjunction with those in adjacent departments (Yvelines and Paris).

TOWARDS A DEPARTMENTAL STRATEGY FOR PROMOTING BIODIVERSITY

On the basis of these large-scale operations, discussion of a cross-departmental strategy to promote biodiversity was launched in 2006. It took place in consultation with all those concerned in the department, looking ahead to sustainable development which takes account of the urban residents' desire to enjoy their natural heritage and restores biodiversity within the heart of the urbanised areas. On 21 June 2007 a conference on biodiversity brought together over 300 participants and produced a list of 51 possible undertakings. These proposals are now being drawn up more formally, grouped under 5 overall goals:

1 – Expanding the knowledge and understanding of biodiversity;
2 – Protecting and managing biodiversity;
3 – Promoting the renewal of biological resources;
4 – Raising awareness and educating;
5 – Making biodiversity a fully acknowledged component of land use planning.

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2.1.2

The Conseil régional of the Ile-de-France (CRIDF) is the governing body of the Ile-de-France region. It is composed of 208 elected representatives, under the leadership of President Jean-Paul Huchon, responsible for governing the Ile-de-France in nine major areas:

1. Transport
2. Education
3. Economic development, employment and training
4. Environment
5. Habitat and housing
6. Social support
7. Culture
8. Sports, leisure and tourism
9. Co-operation

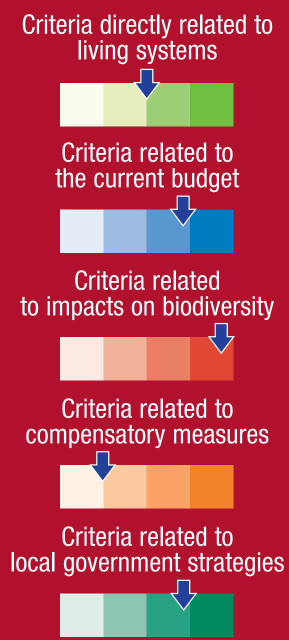
About 20% of the Ile-de-France is urbanised, the remaining 80% consisting of agricultural land, forests and open spaces. One of the obstacles to sustaining biodiversity is the fragmentation of ecosystems, which threatens species survival. A long biodiversity axis, oriented NNW-SSE, comprises chiefly the Vexin français, the major forested areas of Yvelines, Rambouillet and Fontainebleau and the wetlands of the Bassée.

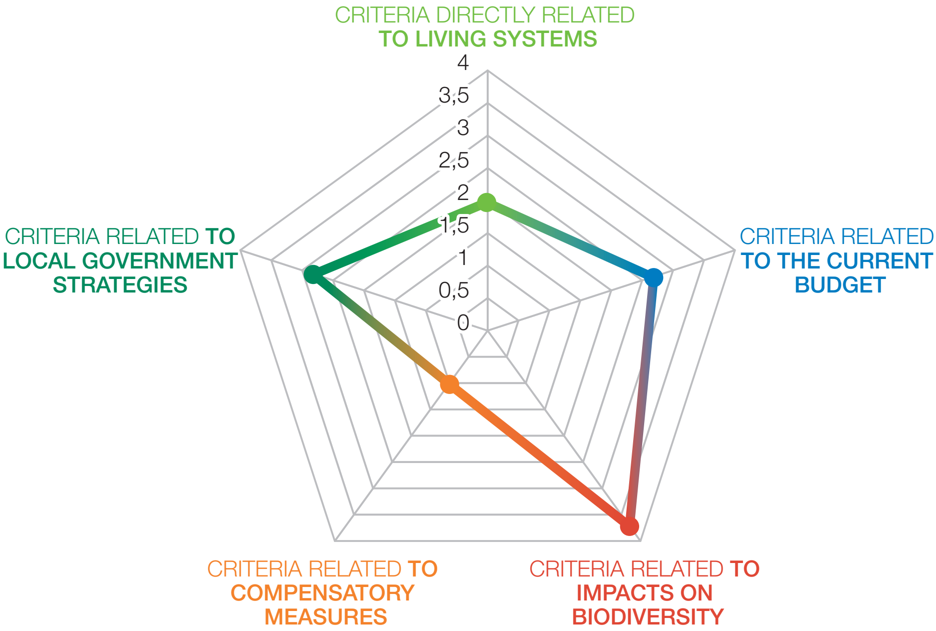
The CRIDF thus has the massive task of managing a number of public services provided to more than ten million citizens. The environmental issues across the region are very substantial. The adoption of a Regional Strategy for Biodiversity and the creation of a Regional Office for Nature and Biodiversity, NatureParif, testify to its commitment. At the core of these approaches lies the desire to sustain ecological continuities across the region and work in partnership with all concerned.

THE CONSEIL RÉGIONAL OF THE ILE-DE-FRANCE IN FIGURES

- **8 Departments:** Essonne, Hauts-de-Seine, Paris, Seine-Saint-Denis, Seine-et-Marne, Val-de-Marne, Val-d'Oise and Yvelines
- **11, 577, 000 inhabitants** as of January 2007
- Total area **12,011 km²** Population density **964 inhabitants per km²**

SELF-ASSESSMENT





> *With its Regional Strategy for Biodiversity, the Conseil Régional of the Ile-de-France has made a concrete and sustainable commitment to preserving biodiversity throughout the region.*

THE INTERDEPENDENCE OF THE ILE-DE-FRANCE REGION WITH BIODIVERSITY

SUMMARY OF THE INTERVIEW WITH *ORÉE* ABOUT THE LOCAL GOVERNMENT AND BIODIVERSITY INTERDEPENDENCE INDICATOR

CRITERIA DIRECTLY RELATED TO LIVING SYSTEMS

Dependence on raw materials derived from living systems

The Conseil régional of the Ile-de-France, the local government serving the region, purchases large quantities of **resources from living systems,** through public procurement: food for school canteens, staff meals and cellulose-based office supplies and furnishings. The size of its fleet of vehicles signals its dependence on fossil fuels from **living systems of past eras.**

2.1.2

Dependence on services and technologies from living systems

At the regional level, it is the inhabitants who benefit daily from **ecosystem services.** The oxygen they breathe, the water they drink and the foodstuffs they eat are among the many examples of these **free services.** Green spaces and nature observation sites form an important **cultural service** which contributes to quality of life in the Ile-de-France. The CRIDF intends eventually to take these ecosystem services into account in developing the region, since they are recognised to be a source of benefits. Approaches based on **biomimetism** exist and need to be centralised in order to disseminate best practices, for example adopting methods from the functioning of natural ecosystems for managing publicly owned forests and green spaces.

Management of the variability, health and complexity of ecosystems

The **variability of ecosystems** is demonstrated via seasonal change, which affects social and economic activities, and by extreme weather (heat waves, storms, floods). This relates to risk control, whether the risks are natural or of human origin. These may lead to additional costs in the short term (of co-operative initiatives, or infrastructure), but can be worthwhile once we consider the extra costs avoided in the medium to long term through prevention efforts. In the same way, the **health of ecosystems** is a very important factor: water and air quality are key parameters to be taken into account in land use planning, and are directly linked to public health. The AirParif office continuously monitors air quality in the region. Taking account of and working with the **complexity of ecosystems** lies at the core of the management policies for the regional parks, but good practices need to be extended to other land areas in order to reintegrate nature into the spaces where people live. Consequently, the strengthening of ecological continuities, gaining knowledge of individual species and monitoring them throughout the region are among the founding principles of the Regional Strategy for Biodiversity.

CRITERIA RELATED **TO THE CURRENT BUDGET**

In addition to the **operating costs** associated with the purchase of products derived from living systems, a **budget line** for the conservation of biodiversity was adopted as part of the Regional Strategy in 2007. The creation of NatureParif, the Regional Office for Nature and Biodiversity in the Ile-de-France, signals the commitment to effective co-ordination of biodiversity initiatives in the region, in partnership with all the local authorities, civil society and the private sector. With respect to the **appeal of the region,** the Ile-de-France can claim to be the first eco-region in Europe. Biodiversity, as a issue which cuts across and lies at the centre of the region's development, will in due course be taken into account in all the CRIDF's operations.

CRITERIA RELATED **TO IMPACTS ON BIODIVERSITY**

The causes of biodiversity loss are manifold: **galloping urbanisation, alteration and fragmentation of the landscape, diffuse pollution** and **invasion by alien species.** Controlling these impacts on biodiversity takes place on two levels: that of the local government itself through its procurement policy, real property holdings and funded projects, and that of the totality of economic operators in the region. However, at this level, the management of impacts is not the responsibility solely of the Conseil régional, except for projects in which the Conseil is the prime mover; all the economic entities are also concerned. In this context, the Master Plan for the Ile-de-France defines the possible and desirable future of the region, both in terms of land use planning and in social, economic and environmental terms, over a period of about 25 years. Besides the efforts already undertaken to reduce pollution, such as the encouragement of rail transport and the taxing of goods transported by lorry, establishing structured urban management plans is a challenge of the moment: ecological continuities and the return of nature to urban spaces needs to be encouraged. This will require conjoined efforts that cut across different branches of the CRIDF and also across public and private institutions in the region. To enable the tracking and evaluation of the activities it funds, the Region has included an agreement on targets in the Regional Strategy for Biodiversity, to be presented to its partners at the time funding is allocated (contracts policies, assistance with infrastructure construction), and also for use in direct operations. These include the management of the spaces owned by the CRIDF, the construction and renovation of schools, and investment in outdoor and recreation facilities.

CRITERIA RELATED **TO COMPENSATORY MEASURES**

Compensation is of indirect concern to the CRIDF, with regard to the development projects it finances, wholly or in part. It also **subsidises** a number of local non-profit organisation projects involving threatened or heritage species, ecological inventories, development of protocols for monitoring specific taxa and the control of invasive species. These expenditures in support of biodiversity are not viewed as compensatory measures but as a new form of regional management.

CRITERIA RELATED **TO LOCAL GOVERNMENT STRATEGIES**

When it comes to biodiversity, the CRIDF can claim **to be exemplary.** It works to promote good practices and encourage all its citizens and economic entities to respect the diversity of living systems. **Dialogue with local stakeholders** makes complete sense for ensuring the success of projects meant to cut across categories, in partnerships with various organisations. The push to increase the **attractiveness of the region** depends on **effective public relations:** consciousness-raising and education are among the stated commitments of the Regional Strategy for Biodiversity. This is expressed via the funding of exhibitions and participation in national nature appreciation days through locally organised activities. The use of wood stoves, HQE initiatives and the recapture of rainwater are all expanding, and today the region is moving towards linking its **public tenders** more closely to biodiversity, so as to develop effective methods to encourage it, such as organic farming. The work done internally by teams focused on environmental issues, via Agenda 21, highlights what has been accomplished since 1999 to make the CRIDF an **eco-friendly administration:** *"What matters is to act practically, to believe in what one does and to convince other people, because ultimately it is individuals who bring projects to fruition."*

Urban biodiversity

2.1.2

The steps taken by the Conseil régional of the Ile-de-France to promote biodiversity

The Ile-de-France is in the fortunate position of possessing an extremely diverse natural heritage. Since the Biodiversity Charter was adopted in 2003, activities have been grouped around three goals: expanding knowledge of living systems, better management of existing open spaces and increasing awareness of the need to consider biodiversity in different policy contexts. The adoption in 2007 of a Regional Strategy for Biodiversity takes up the guidelines of the National Strategy and adapts them to the specific character of the region. The CRIDF has made a commitment to halt the decline in biodiversity in its region by 2010, via ten goals:

- Maintain and restore ecological continuities;
- Develop a network of protected areas;
- Reduce pressure on natural habitats;
- Improve knowledge of biodiversity and monitor its evolution;
- Involve all members of civil society actively in the chosen goals;
- Support them in integrating biodiversity into all policies, across administrative lines;
- Raise awareness of biodiversity by taking an inventory of biodiversity;
- Build co-operative initiatives for biodiversity on levels from the interregional to the international;
- Assess and predict the impact of climate change on the diversity of living systems;
- Lead by example.

CREATING ECOLOGICAL CONTINUITIES ACROSS THE ILE-DE-FRANCE REGION

The regional plan for ecological continuity, a component of the master plan mentioned above, defines priorities, grouped under five networks: waterways, wetlands, grasslands, woodlands and large mammals. The creation of a systematic continuum across the region is to be achieved with the involvement of multiple public and private entities, applied to:

- Water management in the "waterways" plan (SDAGE and DCE);
- The construction of fish ladders at hydropower sites;
- The introduction of wildlife crossings on roadways;
- Gas, electricity and railway embankment transport networks;
- Partnerships with farmers;
- Incorporation of all individual plans in urban planning documents.

In partnership with the Picardy region and within the framework of the national strategy for the development of a green "fabric" throughout the whole of France, the Oise Pays de France Regional Park is working not only to develop ecological corridors but also to determine the consequences of new development such as fences or roadways for wildlife.

Biological corridors: a method for recreating ecological continuities

SUPPORTING PRO-BIODIVERSITY AGRICULTURE: THE PRAIRIE AND ARMAB PROGRAMMES

In November 2000 the Conseil régional approved an agro-environmental programme in partnership with the region's farmers. The "Regional agricultural initiative programme for the respect and integration of the environment" (PRAIRIE) has now been launched. This plan provides direct assistance to farmers with respect to agro-environmental measures for the introduction of more environmentally friendly farming practices: these include reducing chemical inputs and the planting of grass verges and hedgerows. Eight operations are under way, involving 162 farmers; their primary focus is the sustaining of biodiversity, reduction of erosion, maintaining orchards and restoring water quality. Supporting measures are also envisaged for the farmers involved in the projects, including organised activities, training, technical assistance and assessment.

A complementary measure is a programme of assistance with capital investment as part of the Plan for the plant environment: farmers can be reimbursed for up to 40% of the cost of mechanical weeding equipment and planting hedgerows.

In addition, the CRIDF has approved a programme of region-wide assistance with organic farming (ARMAB). This is an amount calculated by the hectare, depending on the type of agricultural production, lasting for a period of five years. It has also established a programme of assistance with paying for "AB" certification, financing 80% of its annual cost.

2.1.2

THE CREATION OF NATUREPARIF, THE REGIONAL AGENCY FOR NATURE AND BIODIVERSITY IN THE ILE-DE-FRANCE, IN 2008

The primary purpose of NatureParif is to support the development and co-ordination of policies to halt the loss of biodiversity, and to take the functioning of ecosystems into account more fully. The agency will encourage interactions among non-profit organisations, institutions, academia and the world of business in order to assist and stimulate the integration of biodiversity into policies. The CSRPN (Scientific Conseil Régional for the Protection of Nature) is the Conseil Scientifique of Natureparif. As such, it can offer an informed opinion on the policies introduced to monitor and assess the state of biodiversity within the region. Consciousness-raising and informational programmes will be addressed to the various sectors of the general public, with the goal of changing behaviours where necessary. Tools for decision-making, guidelines for good practices and an archive of feedback data will also be available to the public, in order to share the expertise acquired.

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2.1.2

The Rhône-Alpes Region includes the departments of Ain, Ardèche, Drôme, Isère, Loire, Rhône, Haute-Savoie and Savoie. The regional capital, Lyon, is also its largest city. The Rhône-Alpes Region is the second-largest in France in area (after Midi-Pyrénées), and second in economy and population (after the Ile-de-France). It is also in pole position with respect to competitiveness and dynamism in Europe.

The internal structure of the Conseil régional is organised in terms of its tasks and responsibilities. The overall divisions - Resources, Personal Development, Education, Sustainable Economic Development and Land Use - are subdivided into 22 departments which are in turn split into different offices. It is these departments which are responsible for the practical implementation of the decisions of the regional councillors.

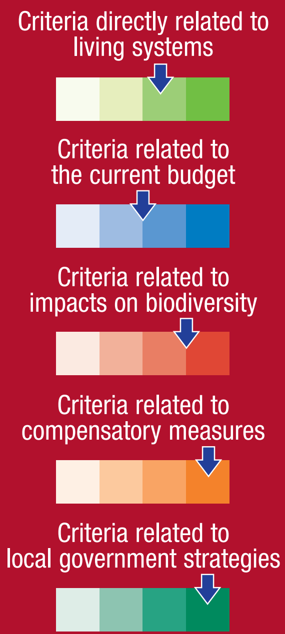
The Conseil régional is run by 157 regional councillors elected for a six-year term by direct universal suffrage. Its role is to manage the Region's affairs through meetings and standing committees. Its responsibilities extend to many aspects of daily life, including transport, schools and employment.

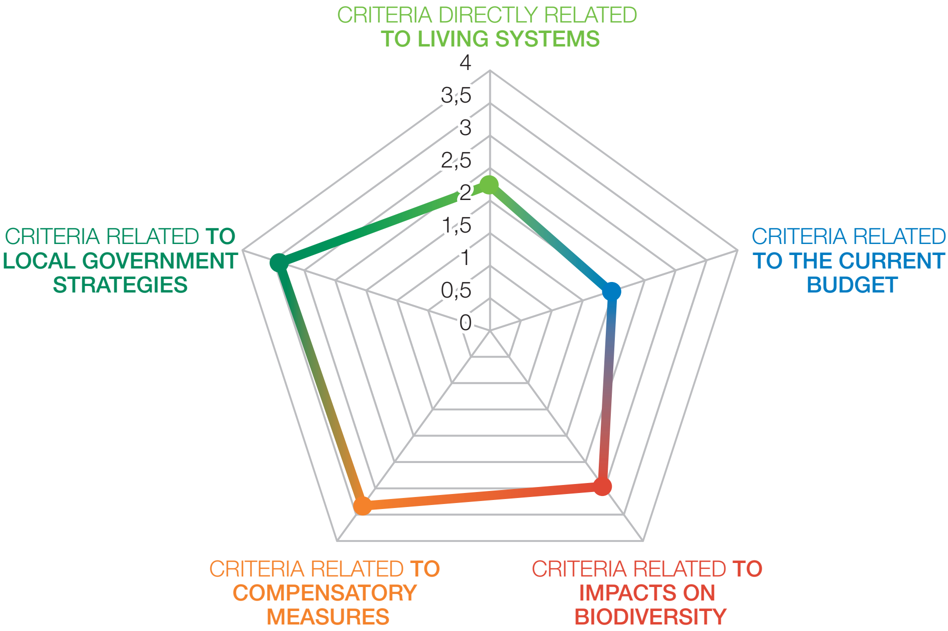
Since 2004, it has been applying the principles of sustainable development in the design and implementation of its policies. The inhabitants of the Rhône-Alpes Region also play an important role in its decision-making: civil society and individual citizens are more and more often consulted with the help of new methods for expanding participatory democracy.

THE RHONE-ALPES REGION IN FIGURES

- The Rhône-Alpes region includes 8 departments and covers **43,698 km²**
- A population of close to **6 million inhabitants**
- GDP of over **145 billion** €in 2002
- **6** Regional Natural Parks

SELF-ASSESSMENT





> *The Rhône-Alpes Region lies at a geographically strategic crossroads where sustainable partnerships are being built between the human population, economic activity and biodiversity.*

THE INTERDEPENDENCE OF THE RHÔNE-ALPES REGION WITH BIODIVERSITY

SUMMARY OF THE INTERVIEW WITH *ORÉE* ABOUT THE LOCAL GOVERNMENT AND BIODIVERSITY INTERDEPENDENCE INDICATOR

CRITERIA DIRECTLY RELATED **TO LIVING SYSTEMS**

Dependence on raw materials derived from living systems

The management of its schools, including the meals served to thousands of pupils, is the responsibility of the Region, and these account for significant consumption of **resources from living systems,** as do the meals for administrative staff and the purchase of furniture and other office supplies. The consumption of fossil fuels by its employees in the fulfilment of their duties is also significant.

2.1.2

Viticulture in the Chartreuse Regional Natural Park

Managing urbanisation in the Alpine valleys, a real challenge for the Region

Dependence on services and technologies from living systems

The challenges associated with managing ecosystems and the **ecological services** that we derive from them are crucial for the future of the Region. Technology cannot always provide a substitute! The Region's inhabitants depend primarily in their daily lives on services like food, water and the very air they breathe. River systems also play crucial roles, from water purification to the delivery of water supplies to aquifers and reservoirs. With 7,000 km of rivers, 4,000 km² of glaciers and hundreds of mountain lakes, the Region has major issues related to water. The Conseil régional acts as a policy-maker and has several mechanisms (regulatory, administrative and technical) to offer the local governments to help preserve these services. At the same time, **ecomimetism** is a new concept which should be tried out internally before other economic entities are encouraged to adopt its good practices.

Management of the variability, health and complexity of ecosystems

The Region's administrative bodies are affected by **ecosystem variability** primarily as this relates to climate change. An integrated policy for anticipating future risks has been adopted. One component of the Plan Rhône focuses on flood control, and the CLIMCHALP programme is studying the impact of climate change on the mountain areas. The **"living systems potential"** of the Region also includes the natural areas on which the Conseil régional can have an effect. The management of invasive species (water primrose, lady's-thumb, ragweed) is becoming a priority in many areas, particularly the regional natural parks which should guarantee **healthy ecosystems.** Managing the **complexity of the ecosystems** in Rhône-Alpes means first and foremost the systematic management of relationships among all the Region's inhabitants, in order to promote sustainable partnerships between human populations, economic activity and biodiversity.

CRITERIA RELATED TO THE CURRENT BUDGET

The **budget allocated to biodiversity** is fairly small relative to overall economic and social priorities, but it has increased in recent years. Approximately 10.5

million Euros are allocated each year to managing the regional natural parks, which are genuine laboratories for the development of ways to live in harmony with nature. With respect to the **attractiveness of the Region,** great importance is attached to eco-friendly approaches, and economic entities, including schools, businesses and the Region's own administrative services, are invited to propose eco-actions. Co-operation across departments and the involvement of all in this approach are crucial.

CRITERIA RELATED **TO IMPACTS ON BIODIVERSITY**

The Conseil régional is not responsible for the totality of the impacts of local government on regional ecosystems. These are many and varied: **air** and **water pollution,** and **habitat fragmentation** by roads, dwellings and agriculture. The Region's geography is a source of constraints and strengths, and **urban development planning** has to be adapted to lowland or mountainous areas. The challenge for today is how to guide economic growth and new infrastructure projects towards the systematic incorporation of environmental constraints and opportunities. In terms of urban planning, the Conseil régional works with local authorities and guides their choices. Subsidies are awarded to construction which best meets environmental requirements, particularly with respect to **integration into the landscape.** Several means of encouraging biodiversity exist and must be strengthened, foremost among them the regional nature reserves and the regional natural parks.

Housing designed to fit into the landscape

CRITERIA RELATED **TO COMPENSATORY MEASURES**

Although the Rhône-Alpes Region is not directly affected by **regulatory compensation,** it is taken into consideration in regional land use planning policies. The Region has to participate actively in the protection of sites of ecological interest and the maintenance of continuities. The part of the budget allocated to biodiversity is incorporated into this **voluntary approach,** including environmental inventories, costs of management and restoration of sites.

2.1.2

CRITERIA RELATED **TO LOCAL GOVERNMENT STRATEGIES**

With its eight departments, the Region possesses a tremendous variety of landscapes and species. The regional environmental policy therefore strives to be comprehensive, covering the totality of the area, from the mountains to the coastline, and all the stakeholders, from elected officials to businesses to citizens. It seeks to encourage responsible consumption by its inhabitants, through the promotion of organic farming and AOC products. For businesses, it finances **environmental innovation** through subsidies or tax credits. With respect to tourism, biodiversity constitutes a true **economic opportunity,** underwriting the Region's increased attractiveness, which has to be further enhanced and preserved through eco-friendly practices and activities. Moreover, **social pressure** is being applied by non-profit organisations, which are seeking more and more funding and support from the Conseil régional. The administration is very open to their proposals and to those of scientific researchers with whom it hopes to strengthen partnerships. Preserving natural areas or saving threatened species in isolated zones is not enough. The challenge for today is to **integrate biodiversity into all areas,** be they **rural** or **urban:** this is what underlies the **threefold injunction** *"to raise awareness, to inform and to educate"'* and so to change the way we live. With this in mind, in May 2008 the Region organised the Europe-wide conference, "Biodiversity and regional development", in partnership with the Conservatoire Régional des Espaces Naturels de Rhône-Alpes (CREN). **Informational materials** are addressed to the public in general, but are aimed especially at young people, who will pursue tomorrow's projects.

The steps taken by the Rhône-Alpes Region to promote biodiversity

EVERYONE IN THE RHÔNE-ALPES REGION IS INVOLVED: THE CONSEIL, THE CITIZENS, NON-PROFITS AND BUSINESSES

Protection of the natural heritage is accomplished through the involvement of all, from local residents to businesses: to raise awareness and assist them in their initiatives, official informational materials are made available and the Conseil régional helps to finance innovative projects to promote the image of an eco-friendly Region.

Developing special partnerships with non-profit organisations and local residents

The Region has underwritten the development of two "red lists" of threatened species in Rhône-Alpes. Produced by the Centre Ornithologique and the Sympetrum group, an association for protection of the Region's dragonflies, the lists cover land vertebrates and Odonata (dragonflies). The Region and the Conservatoire Régional des Espaces Naturels have also collaborated in an assessment of the resources available for the preservation of natural areas in Rhône-Alpes. Lastly, in collaboration with the Fédération Rhône-Alpes de protection de la nature, it is preparing a report, the fruit of a year's work, which lists 88 ways to protect biodiversity in the Region.

To involve its inhabitants, the Region is conducting a trial project in the schools, to last through 2008. Twenty-eight schools have volunteered for this collective project, in which one or more ecology-related ideas are to be put into practice by those at the school and in the everyday management of the school, such as waste recycling and organically grown food for school meals. Ultimately, this initiative is to be extended to all the schools in Rhône-Alpes.

Getting business involved

By creating jobs and wealth, local businesses contribute to the expansion and vitality of the Region. They also use natural resources, consume energy, generate pollution, produce waste and contribute to the erosion of biodiversity. Change in their production methods is thus crucial: biodiversity is a new challenge for businesses, and they must answer the challenge. The Conseil régional supports businesses committed to more eco-friendly voluntary management strategies and manufacturing processes. To promote these changes in modes of production, it has established a comprehensive intervention plan, ranging from direct assistance to help with public relations.

2.1.2

BIODIVERSITY AT THE CENTRE OF ECONOMIC ACTIVITY IN THE MOUNTAINS

With 51% of its population living in upland areas, 65% of its territory classified as mountainous and 73% classified as upland, Rhône-Alpes is without question a mountain region.

Mountains constitute a natural and cultural heritage which is unique but fragile. Generally accessible, but faced with problems of transport infrastructure, it is also a recreation area where environmental challenges associated with tourism are everywhere present. Mountains are affected by natural hazards and urban and land use pressures. The local knowledge possessed by the inhabitants of mountainous areas, such as crop rotation, medicinal plants or forestry, is crucial for the preservation of ecological balance.

In its management of biodiversity, the Conseil régional goes beyond the mere preservation of natural heritage in nature reserves. While these reserves form a necessary refuge for many species, the preferred perspective goes beyond the "bell-jar" approach of isolating specific tracts of land, and is moving towards taking all stakeholders and sectors of activity into account in its planning. The management of mountainous areas can be divided into four strategic domains related to the interactions between humans and nature:

- Livestock breeding and agriculture;
- Water management;
- Responsible tourism;
- Forest management;

In 2005 the Region initiated a discussion of the special issues of development and protection of mountain areas, which resulted in the adoption of a regional strategy for mountain areas in late 2006. This strategy is organised into 13 aspects and 70 actions, focused on:

- Fuller attention to mountain areas in all intervention policies;
- Developing inter-regional programmes for upland areas, in conjunction with the state, partner regions and all those concerned with mountain areas;
- Initiating international co-operation on the issues specific to mountain areas.

As part of its strategy for the mountain areas, the Region has also pledged to give high-priority support to mountain areas in difficulty. A call for proposals on *"Outstanding mountain areas: innovating and transferring experience in upland areas"* seeks to achieve this goal.
Two types of programme are supported:

1) Innovative projects for the development and preservation of mountain areas under threat;
2) Transfers of experience from the six regional parks to areas where there is a lack of environmental engineering resources.

FOR MORE INFORMATION

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2.1.2

VILLE DE CHÂTILLON

Châtillon is a French municipality in the Hauts-de-Seine department of the Ile-de-France region. It is surrounded by the municipalities of Bagneux to the east, Clamart to the west, Malakoff to the north-west, Montrouge to the north-east and Fontenay-aux-Roses to the south.

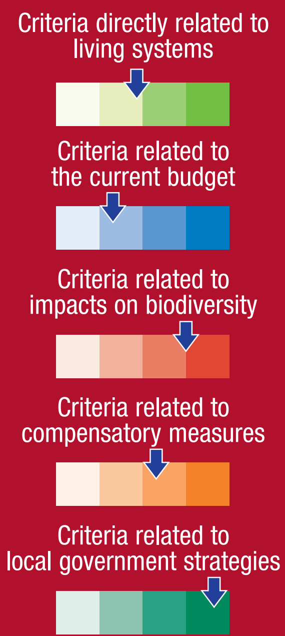
Jean-Pierre Schosteck, a UMP deputy, has been mayor since 1983. The municipality has been firmly committed to eco-responsibility since June 2006. Today, straightforward actions and pragmatic measures are necessary. Every citizen and economic entity, including the local authorities, has a shared responsibility for a world to be handed down to future generations.

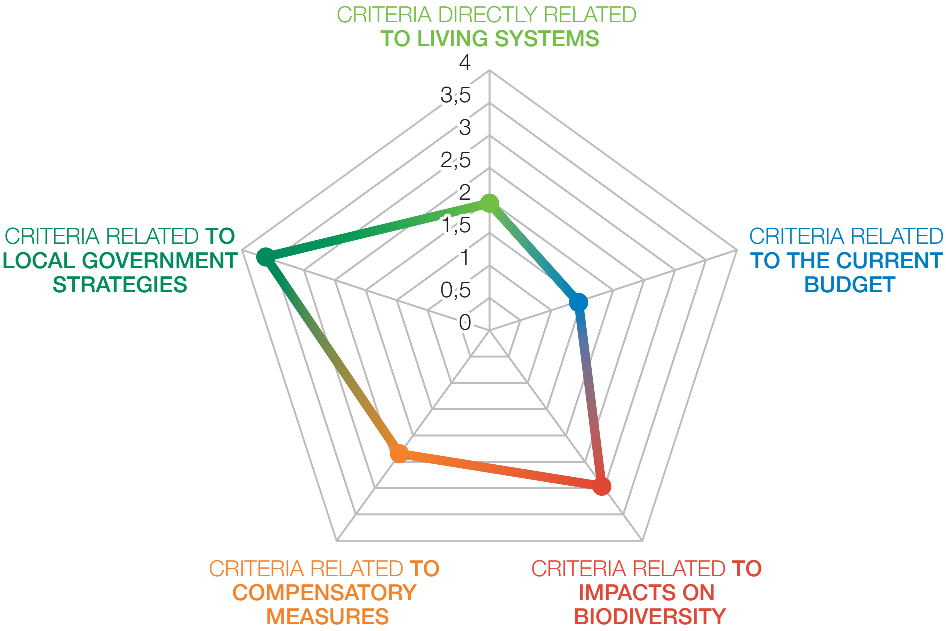
For Châtillon to be an eco-friendly town means encouraging and sensitising all the participants in the life of the locality, whether municipal employees, educators, the non-profit sector - all the residents of Châtillon - by setting an example of changed behaviour designed to preserve our environment.

CHATILLON IN FIGURES

- A town of **28,788** residents in the Hauts-de-Seine department
- **35** elected members of the Conseil municipal
- Total area of **292** ha including **12** ha of parks and green space
- **700** municipal employees working for the town

SELF-ASSESSMENT





> *Châtillon, as an eco-friendly town, goes beyond lip-service to offer its residents practical methods for preserving their environment.*

THE INTERDEPENDENCE OF THE TOWN OF CHÂTILLON WITH BIODIVERSITY

SUMMARY OF THE INTERVIEW WITH *ORÉE* ABOUT THE LOCAL GOVERNMENT AND BIODIVERSITY INTERDEPENDENCE INDICATOR

CRITERIA DIRECTLY RELATED TO LIVING SYSTEMS

Dependence on raw materials derived from living systems

The interdependence of the town of Châtillon with living systems can be analysed on two levels, that of the Conseil municipal and that of the town's citizens. The administration is directly responsible for the elementary school and nursery canteens, and therefore for the **raw materials derived from living systems** consumed there on a daily basis. In addition, it owns approximately a hundred vehicles, many of which now run on natural gas. Indirectly, the town's residents consume a large amount of foods-

2.1.2

tuffs, and buy many products made from **materials derived from living systems of the past and present,** such as medicines. The residents of Châtillon themselves also own a substantial number of vehicles.

Dependence on services and technologies from living systems

The urban ecosystem, like all ecosystems, is composed of living organisms, including humans, and inorganic materials (building materials, such as aggregates), all of them continuously interacting and changing. But there is one major difference between urban ecosystems and others: towns and cities depend on the **ecosystem services** they derive from other ecosystems, both rural and wild. Water supply and purification, foodstuffs, carbon storage and the production of oxygen are services essential to urban life. Moreover, for many citizens, bringing the natural world into the urban one is identified as a source of well-being, and green spaces thus provide the population with **cultural services.**

Management of the variability, health and complexity of ecosystems

While the changing seasons affect both the management of public green spaces and the behaviour of consumers and citizens, the effects of the **variability of ecosystems,** in both biological and physical-chemical ways, are difficult to assess. However, the **health of the ecosystem** has a profound impact on that of its inhabitants: water and air quality affects their health and can sometimes generate extra costs for the municipality (the cost of supplying water, pollution remediation). With respect to the **complexity of ecosystems,** the expansion of diversified green spaces within the town may be equated with increased attractiveness, as long as the users are made aware of this connection. However, this can also generate additional management costs.

Managing the everyday relations of the citizens with living systems and encouraging them to be eco-friendly both individually and collectively is a complex task.

Composting green waste in Châtillon

CRITERIA RELATED **TO THE CURRENT BUDGET**

The **municipal budget allocated to biodiversity** is still small. Purchase of food for schools and garden products for green spaces constitutes the bulk of the operating costs related to living systems. **Expenditures** for other environmental concerns (waste management) are more significant. The Conseil municipal has made eco-responsibility an active force enhancing the **town's appeal.** It is a key feature in the eyes of citizens in search of an improved, more environmentally friendly, quality of life.

CRITERIA RELATED **TO IMPACTS ON BIODIVERSITY**

The department of Hauts-de-Seine has one of the highest population densities in France, and Châtillon, in the south-east corner of the department, is no exception. The new regional urban Master Plan promotes the **integration** of **new infrastructures into the landscape,** for example via HQE® construction. While pollution from many sources (greenhouse gases, effluents, waste) is present in the urban area, Châtillon is firmly committed to reducing it on an everyday level. The town has little biodiversity because it forms part of the Paris conurbation, and the **conversion** and **urbanisation** of **natural habitats** has already affected almost the entire region. What is to be done in this situation? By installing nesting boxes in strategic locations, the town gives birds a place to live. Ecological management of green spaces can also create little islands of biodiversity within the town.

CRITERIA RELATED **TO COMPENSATORY MEASURES**

Since Châtillon has been completely urbanised for a long time, the issue of **regulatory compensation** does not arise. In addition to everyday eco-friendly actions on a small scale (energy-efficient appliances, organic products) and major development projects for more ecological transport systems (the tramway), **voluntary activities** to help restore biodiversity will be envisaged in due course, in partnership with community groups.

CRITERIA RELATED **TO LOCAL GOVERNMENT STRATEGIES**

Ecological issues are central to the concerns of importance to Châtillon, from the active **promotion of the town as eco-friendly** to the "Biodiversity Day" held in conjunction with "Sustainable Development Week". Although biodiversity can be a somewhat vague concept for citizens and town employees whose responsibilities are very various, it affects everyone on a daily basis. **Community groups exert positive pressure** to move discussions forward and to propose and implement concrete plans. In the future, practical ways must be found to encourage the return of biodiversity to the town.

2.1.2

The steps taken by the town of Châtillon to promote biodiversity

CHÂTILLON, THE ECO-FRIENDLY TOWN: SETTING A GOOD EXAMPLE

The municipality, keen to focus on practical action rather than long speeches and useless documents, has set numerical targets for eco-responsibility. In 2006, town councillors voted an agreement on goals for the following three years, namely:

- 20% reduction in water consumption in town offices;
- 10% reduction in energy in public buildings;
- 60% recycling of office paper and reduction of paper consumption by 5% per year over five years;
- 5% decrease in the amount of rubbish collected;
- Reduction of air pollution (20% clean-fuel vehicles), 10% reduction in CO_2 generated by town-owned vehicles;
- Incorporation of sustainability as a criterion in public tenders;
- Encouragement of clean transport.

Sorting rubbish and consuming responsibly

Châtillon has embarked on a policy of reduction in consumption, both by the administration and by its citizens. The consumption of paper, water and energy and the pollution generated by town-owned vehicles are monitored, and the municipality encourages responsible behaviour. Waste sorting is already being carried out in the town offices, and has been actively facilitated on the streets (a first in France) and in the schools, thereby limiting the increase in tonnage of household waste. The results are monitored via indicators published every six months.

Waste composting

Compost is the result of the processing of organic waste by micro-organisms in the presence of water and oxygen. It is similar to humus and extremely useful in both agriculture and gardening. By composting green waste and the organic ingredients in household waste - twigs, grass clippings, dead leaves, coffee grounds, tea-bags, eggshells and vegetable peelings - the citizens can both reduce the amount of waste they throw away and also improve the soil in their gardens.

The local government is determined to limit the amount of waste the town collects and processes: it provides households with individual closed composting units with a capacity of 350 litres.

Individual composting will not only reduce pollution related to transport of waste materials and disposal via storage or incineration, but also make use of the materials by returning them to the soil.

Nesting boxes installed by individual residents

Urban animal and plant life

To encourage the return of birds to the parks, nesting boxes with entrance holes of different sizes have been installed. We should remember that most birds are insectivorous, and that their presence reduces the need for insecticide treatments, acting as a form of organic pest control. The goal is to keep the birds returning, and to enable them to raise their offspring in security, safe from predators. This approach also has the merit of stimulating the curiosity of the park users, who can watch the bird behaviour, a cultural service provided by nature.

Integrating biodiversity into everyday urban life – an ideal or tomorrow's reality?

This is a question of commitment to a long-term vision of the town, its residents and their relations with living systems. The municipality has the opportunity to raise awareness and influence residents' behaviour through their interactions with the diversity of the living world and through the consumption of food, housing, work, leisure areas, roadways and waterways, or health services. There are many ways to work on biodiversity!

FOR MORE INFORMATION

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2.2 BUSINESSES AND LOCAL GOVERNMENTS IDENTIFY KEY ISSUES

2.2.1 The economy as a whole interacts with biodiversity

Through the interviews and self-assessments held in connection with the Business and Biodiversity Interdependence Indicator (BBII)[3], the interviewees have discovered that interactions between businesses (or local governments) and biodiversity:

- **Occur, overtly or otherwise, on a number of levels,** from industrial sites to surrounding areas, from the local to the international level, from production units to company headquarters, and from subsidiaries to parent organisations.
- Concern **numerous functions and skills** within organisations, from innovation to production cost control, accounting to taxation, management of social pressures to business or procurement strategies, and from public relations to training of employees.

The use of the BBII has prompted a number of strategic questions for the organisations which have contributed self-assessments to this book. These questions highlight the need for technological, organisational and institutional innovation. For example:

- With respect to the criteria dealing with direct and indirect dependence on raw materials derived from living systems, how can an organisation be certain that its **sources of supply ensure the viability of biodiversity?** What are its responsibilities vis-à-vis the **impacts of its suppliers and subsidiaries?**
- How to **sustain the ecological services** which businesses and local governments derive at no cost from ecosystems? Conversely, how could economic activities supplying ecological services be remunerated?
- How to rethink production processes so that to promote the variability and complexity of ecosystems, biodiversity and organisations? How to **encourage** and **expand** the **reciprocal relations** between the **production of goods and services** and the **viability of ecosystems** and that of **their biological components?**
- How to rethink **marketing** and **client** or **customer education** in the face of all these challenges? What are the implications for **public relations** and **CSR reporting?**

These questions also underscore the pressing need to attend to the interactions among organisations on the issue of biodiversity: for instance, for the agro-food industry, the cosmetics and perfume industry, the finance industry, the economic interactions between regions across national borders, which involve government authorities and international organisations. The self-assessments presented in this study[4] illustrate clearly that the economy as a whole interacts, directly and indirectly, with the diversity of living systems. They offer valuable suggestions for meeting the challenges posed by the increasing erosion of biodiversity.

(3) Local Government and Biodiversity Interdependence Indicator (LBII) in the case of local governments; see appendices, p. 362.
(4) Sections 2.1.1 and 2.1.2, respectively at pages 70 and 208.

2.2.1

BOX 8: THE INTERDEPENDENCE OF MEDICINE AND BIODIVERSITY: THE VIEWPOINT OF A GENERAL PRACTITIONER

By Marc BARRA[5]

Health is not just a matter of pathology. It concerns all the benefits we derive from biodiversity, including our food and general well-being. Biodiversity is also a **source of raw materials** for medicine, for example the active ingredients derived from plants. It is a source of **innovation** and **biotechnology,** in the case of GMOs for medical purposes or stem cell manipulation. Vaccination, which applies the mimetic properties of an antigen to the cells of the immune system, or the use of leeches *(Hirudo medicinalis)* to speed up the healing process, are good examples of biomimetism. The pharmaceutical industry consumes in addition many petroleum-based products *inherited from the living systems of past eras,* such as chemical solvents or single-use syringes and surgical gloves.

When we think of the effects of the **variability** and **complexity of ecosystems** on the evolution of interactions between host organisms and parasites, we realise that human health is closely linked to that of ecosystems. Climate vagaries, for example, determine the distribution of species of Anopheles mosquito and hence modulate the incidence of malaria transmission[6]. What will be the consequences of **climate change** for the evolution of populations of pathogens[7]? We should not underestimate the importance of healthy ecosystems for the natural regulation of pathogenic phenomena and for reducing the need for medical intervention in emergencies, such as expensive vaccination campaigns. According to Chivian, *et al.* (2008)[8], the erosion of the diversity of living systems is likely to be disastrous for the health of future generations.

Changing ways of life and medical treatments have forced medicine to adapt to new needs, often far distant from its primary and essential obligations. In addition to the search for therapeutic efficacy, there has been a recent trend towards "comfort" products. For a discipline which has long been focused on human life, a complementary and vital task is the **better understanding of the complexity of living systems,** in its biological, economic and social dimensions. Facing up to new challenges, such as the growth of resistance to antibiotics, requires "teaming up" with life, not seeking to deny its dynamic and evolving characteristics. This gives credit to preventive medicine and health education, particularly at the level of dietary practices. A renewed, adaptive medicine would without doubt necessitate a better understanding by all of the **interactions between humans and non-humans.**

(5) Student, Masters Ecology - Biodiversity - Evolution, University of Paris-Sud 11, Orsay faculty of science.
(6) Mouchet, J., Carnevale, P., Coosemans, M., Julvez, J., Manguin, S., *et al.,* 2004. Biodiversité du paludisme dans le monde. J. Libbey Eurotext, Paris, 428 pp.
(7) Guégan, J.F., Renaud, F., 2005. Vers une écologie de la santé. In: Barbault, R., Chevassus-au-Louis, B., Teyssèdre, A. (eds.), Biodiversité et changements globaux: Enjeux de société et défis pour la recherche. Ministère des Affaires Etrangères-ADPF, Paris, 100-116.
(8) Chivian, E., Bernstein, A., 2008. Sustaining life: how human health depends on biodiversity. Oxford University Press, Oxford, 568 pp.

2.2.2 Future directions based on BBII self-assessments

The main finding of the classification of industries in terms of their direct dependence on biodiversity[9] has been verified: living systems considerably shape economic activity. Environmental issues are no longer viewed as a set of disconnected criteria, with CO_2 emissions or waste management in first place on the to-do list. The BBII composite indicator can enlighten businesses and local governments about *the nature of their interactions with biodiversity*, moving towards an ecosystem approach to organisational functioning. In this way, organisations can position themselves and *undertake meaningful discussions about their interdependence with biodiversity*, even if a formal characterisation of their relations with living systems vis-à-vis some of the criteria is sometimes difficult. In particular, reliance on ecological services and the use of biomimetism are still not very tangible notions for many organisations, pointing to the need for expanded education on these topics.

Some of the BBII criteria may give rise to problems and uncertainties owing to lack of in-house expertise or the need for collective decisions about the future of areas involved: these include the *reversibility of impacts*, the *management* of the *complexity* and *variability* of ecosystems and the concept of *compensation for damages.* We are still in a phase of problem definition when it comes to the subjects covered by these *criteria bearing on the interactions between organisations and biodiversity.* While the BBII enables a better understanding of the risks and opportunities associated with biodiversity, the questions it leaves us with are: *how can we pull together the various perceptions of interactions and issues*, whether those of stakeholders or those internal to organisations, towards **collective management** and **shared responsibility** for the evolution of biodiversity? How can we *speed up* the creation of suitable policies and practices which will lead to the **co-viability of organisations and the diversity of living systems?**

In the hope of answering these questions and reinforcing the best practices presented in the self-assessments, the third section of this work will attempt to identify the primary courses of action needed to establish **sustainable partnerships between organisations and the diversity of living systems.** It will first seek to understand more precisely the **nature of the influences companies have on the evolution of living systems,** that is, *to define the dynamics of co-evolution of businesses and ecosystems.* Subsequently, **a new model of development will be proposed to businesses,** and its challenges, constraints and opportunities will be highlighted. Finally, the methods and tools to be newly created or brought into play for mutualistic relationships between biodiversity and businesses will be outlined: the ***Biodiversity Accountability Framework*** will propose an accounting system for reintegrating economic activity into biological diversity.

(9) See section 1.2.4, page 52.

SECTION 3
REINTEGRATING ECONOMIC ACTIVITY INTO BIODIVERSITY

3.1 UNDERSTANDING THE INFLUENCE OF BUSINESSES ON THE EVOLUTION OF LIVING SYSTEMS

The research carried out by the *Orée*-IFB Working Group has highlighted the interactions between business and biodiversity and presented some businesses' own perceptions of their interdependence with biodiversity. However, a key question remains to be answered: what kinds of influence do businesses have on the diversity of living systems? To answer this question we need to recall the fundamental characteristics of living systems and the inputs of systems ecology and industrial ecology, in order to better understand the evolution of industrial systems within the biosphere.

3.1.1 Chance underpins biodiversity and its evolutionary dynamics

As explained by Alain Pavé (2007), *"one of the fundamental characteristics of living systems is their capacity to organise themselves into increasingly complex nested structures: genomes, cells, organs, organisms, populations, communities and ecosystems".* Their connections and interactions can be presented as a hierarchy of living systems, with a qualitative shift as we move from biological systems to ecological ones, since components of ecological systems do not exhibit genetic coherence. Pavé (2007) stresses the **importance of "chance" in the functioning and evolution of living systems:**

- A number of mechanisms *alter genomic sequences quite randomly,* apparently without any underlying determinism responsible for their onset. These mechanisms can operate on different levels, from nucleotides up to assemblies of genes, and include both endogenous dynamics (one-time mutations) and horizontal transfers of some parts of the genome across distinct species (viral vector transduction). Modulation of DNA repair systems may exacerbate the effects of these mechanisms, which make them a likely explanation for the diversity of individuals within populations of a single species.
- Other random mechanisms play crucial roles in the **genetic mixing** – *thus in the creation of diversity* – associated with **sexual reproduction,** from the genesis of reproductive cells up to gamete fusion. Even the choice of a sexual partner is mostly contingent on environmental factors, mobility and the modes of movement of organisms, as is illustrated by salmon species among many others, even sedentary ones.
- At the level of ecological systems, where we speak of interactions among all the components of biodiversity, **random gene expression** during cell differentiation (Paldi, 2007), in conjunction with the **random spatial distribution** of numerous organisms (Pavé, 2007), are fundamental but often undervalued features. Low densities of a large number of species inhabiting diversified ecological niches underlie the emergence of the ecosystems richest in biodiversity, such as rainforests and coral reefs. Within biotopes undergoing change, random spatial distributions and epigenetic landscapes, in which genes are only one variable among others, **can bypass competitive exclusion and protect against stresses, shocks and surprises.**

These *"biological roulettes"*[1] guarantee the diversity of living systems and their evolutionary capacity in uncertain, changing environments. Living systems are diversified, self-regulating and adaptive, which means that "accidents", unexpected events do not happen just anywhere and anyhow. Too many random phenomena could damage their capacity to self-organise, self-regulate and adapt. In other words, *randomness-generating mechanisms are necessary for the survival and evolution of living systems,* including that of humans in all our cultural, linguistic and organisational diversity, as well as for our policy and development choices, economic models and industrial systems. These *biological roulettes* underpin the diversity of living systems and their evolutionary dynamics: attempts to control them can have major consequences for the evolution of biodiversity. If **diversity, change** and **variability** are the **true insurance policies for the success of life on Earth** (Barbault, 2006; Pavé, 2007) and for the (free of charge) ecosystem services which form the bedrock of our economy, what is the nature of the interaction dynamics between businesses and living systems which are contributing to the increasing erosion of biodiversity? Before providing some answers to this question, we must first examine the links between businesses and ecosystems.

(1) As called by Pavé (2007) in reference to the gambling game "roulette".

3.1.2 From systems ecology to industrial ecology

Initially, it was research in systems ecology which led to a better understanding of the interactions between the economy and ecosystems (Odum, 1983; 1996). Viewing these interactions from the perspective of thermodynamics demonstrates that the economy is part of the biosphere. Ecological economics perceives economic activity as the material expression of the interactions between people within ecosystems. The economy constitutes a subsystem **that is totally dependent on the global ecosystem of finite dimensions we call the biosphere.** It is characterised by the *unidirectional flow of energy* which emanates from the sun, accumulates in the biosphere (biomass, minerals) and, through the production of goods and services, is dissipated completely in the form of available useful energy towards energy incapable of doing further work; for example, by burning fossil fuels to make a vehicle move. From this perspective, the economy can be perceived in an entirely new way, **as a machine for consumption rather than production** (Rees, 2003).

Neo-liberal economists are concerned exclusively with the "goods" and "services" of "economic transactions"; hence the "environment", which belongs to no one and is not involved in any transactions, strictly speaking[2], is left out of the market. However, ecological economics focuses both on the **inputs necessary for "economic consumption"** and on their **outflows,** that is to say the waste products and by-products of humans and their industrial systems (Georgescu-Roegen, 1971). These systems are unlike autotrophic organisms (such as plants[3]), but similar to "heterotrophic" living organisms also known as primary consumers. Waste and pollution then appear as the inevitable results of modes of consumption and of the industrial transformation of matter and energy (Erkman, 1997).

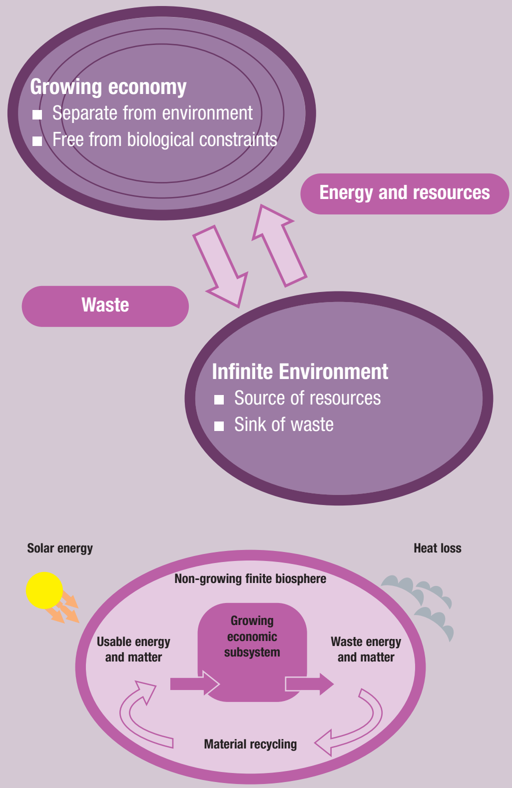


Figure 8 : A comparison of neo-classical economics and ecological economics. The first diagram shows the neo-classical view of the relationship between the economy and the environment: this economy is open-ended and growing, as an autonomous system disconnected from the environment. Ecological economics also sees the economy as open-ended and growing, but totally dependent on the biosphere, which is a closed, finite system (adapted from Rees, 2003).

(2) Fish or minerals do not have a price in and of themselves. Only access or use rights, machinery or workers necessary for their exploitation give rise to economic transactions.
(3) Plants need only energy and basic elements to produce large amounts of biomass.

3.1.2

Research in industrial ecology, including that conducted by *Orée* (Schalchli, *et al.*, 2008)[4], are founded on biomimetism and systems ecology: industrial parks and networks of companies are analysed as sub-systems within the biosphere. Present-day industrial systems are characterised by (a) the fairly small number of interactions among their constituent "organisms" (factories, businesses) and (b) their unlimited production of waste, due to the unidirectional dissipation of flows of energy and matter (the "current situation" presented in figure 9; Allenby and Cooper, 1994). Strategies and methods must then be developed for the cyclical functioning of industrial systems - and of the economy in general, to enable them to produce and recycle in the way that ecosystems do (Erkman, 1997). Businesses could co-operate by *closing the matter and energy cycles of all their production lines and supply chains*, from the extraction of raw materials to the end-of-life of their goods and services (Schalchli, *et al.*, 2008; Tudor, *et al.*, 2007). For example, perennial energy and matter exchanges have been set up in the industrial zone of Kalundborg in Denmark, a model which has attracted a lot of media coverage. Analysis of the successes and limitations of various industrial ecology approaches will no doubt stimulate further research into:

- Interactions between parties, particularly with respect to the dynamics of co-operation between businesses (Tudor, *et al.*, 2007);
- Synergistic substitution and pooling of resources (Schalchli, *et al.*, 2008);
- Development of appropriate indicators and units of measurement (Seager and Theis, 2004).

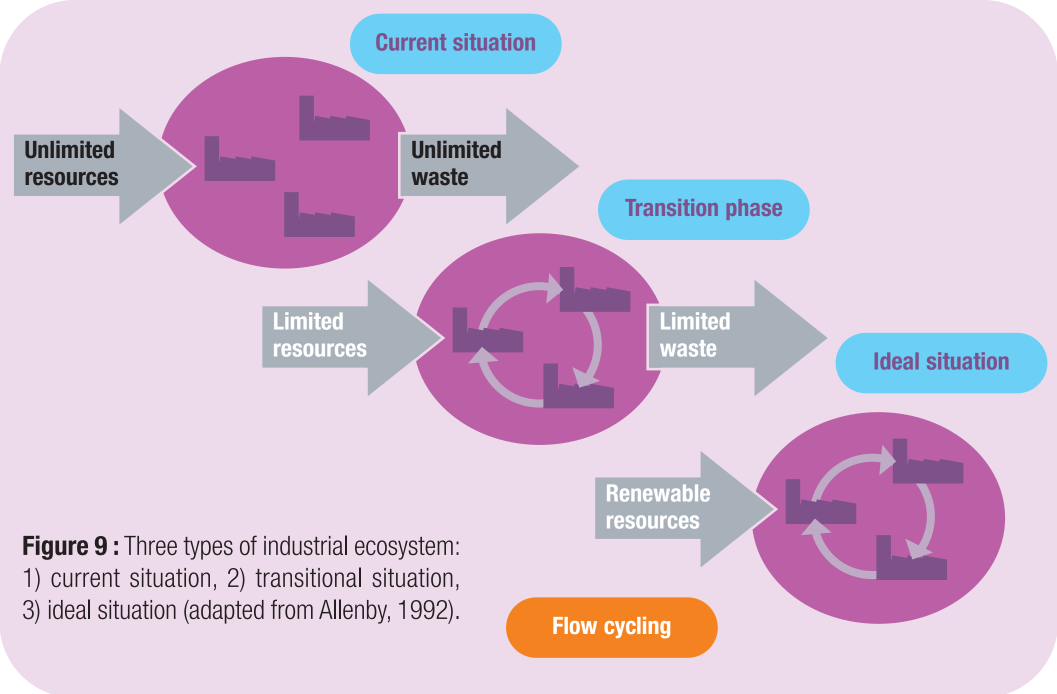


Figure 9 : Three types of industrial ecosystem: 1) current situation, 2) transitional situation, 3) ideal situation (adapted from Allenby, 1992).

(4) The COMETHE (Conception d'Outils METHodologiques et d'Evaluation) project, co-ordinated by *Orée*, focuses on the development of methodological and assessment instruments for industrial ecology: http://www.comethe.org/.

When expanded beyond the boundaries of industrial parks, industrial ecology can lead to rethinking both regional development strategies and the functioning of international networks of companies, via the analysis of their supply chains (Linton, *et al.*, 2007; Zhu and Cote, 2004). It emphasises the decarbonisation and dematerialisation of the economy, which will promote the productivity of resources and the closing of energy and matter cycles. In the resulting economy, the sale of goods will give way in large part to the sale of services, such as the cleaning of machinery to recover and reuse oil which used to be wasted and replaced via new purchases (Erkman, 1997).

Research into systems ecology and industrial ecology demonstrates that the **development of businesses is intrinsically linked to that of the ecosystems to which they belong** (Shrivastava, 1994).

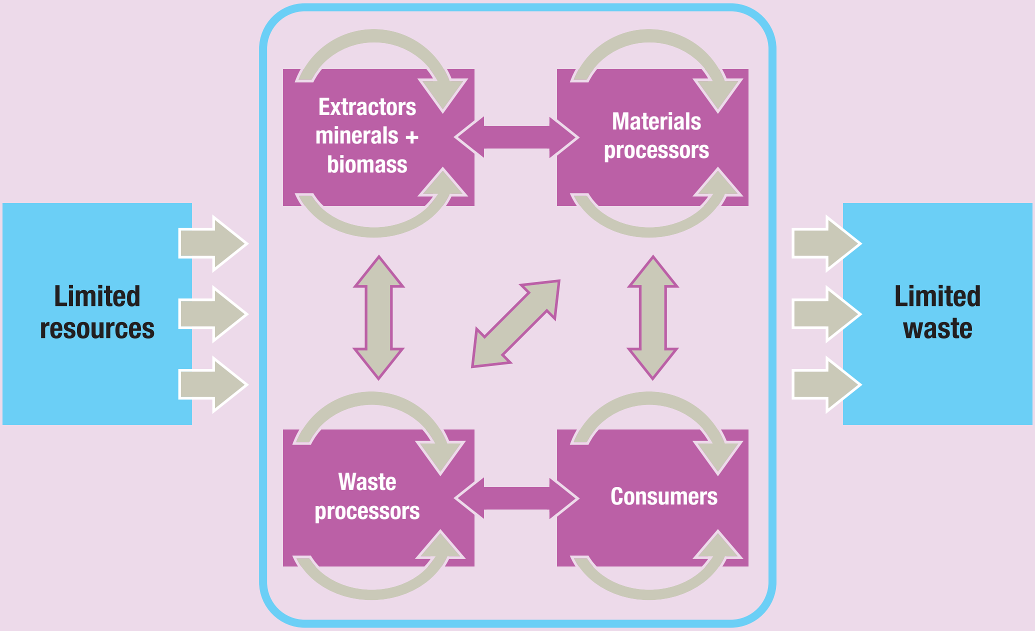


Figure 10 : Diagram of a mature “industrial ecosystem” (adapted from Erkman, 2006).

3.1.3 Are businesses responsible for the world-wide homogenisation of biodiversity?

Human communities modify, sometimes irreversibly, the ecosystems on which they depend. Feedback effects (or consequences) on our ways of life, especially in the areas of health and nutrition, are the outcome : these may include degraded air and water quality as well as additional costs associated with the increasing scarcity of renewable resources. Norgaard (1985) argues that **we are both witnesses and participants in the co-evolution of ecosystems and socio-economic systems.** One example of this co-evolution is the reciprocity between agricultural pests, pesticides, the regulation of pesticide use and the cultural assessment of their use: knowledge, values, types of organisation, technology and ecosystems are all in continuous interaction (Norgaard, 1984; 1994). We could pursue this analysis in anthropological terms, arguing that people - citizens and consumers - both individually and collectively, and especially via organisations such as businesses, are "obliged" for the "gifts[5]" which they have "accepted" from the ecosystems within which they live and with which they evolve[6]. Is it possible to construct "social ties" with the diversity of living systems?

The self-assessments performed with the help of the *Business and Biodiversity Interdependence Indicator* and presented in the second section of this publication include many examples of reciprocal interactions between biodiversity and businesses operating in various sectors. These interactions have been analysed from various angles: the goods, services and technologies they derive from living systems, social pressures, sales, impacts and compensatory measures, among other criteria. Although the interactions are sometimes indirect or negligible, this exercise has nevertheless confirmed that the economy as a whole interacts with biodiversity.

Once we accept that businesses and ecosystems form part of one single system and that they co-evolve within the biosphere, the next question is: **What is the nature of the interactions between businesses and the diversity of living systems?** The key to answering this question lies in understanding the nature of reciprocity between global networks of businesses and biodiversity, with respect to selective pressures and irreversible effects. Porter (2006) points out **the need to distinguish** between **co-adaptation,** which is temporary, and **co-evolution,** which takes the form of permanent changes in practices and strategies. There are many kinds of adaptation, such as "greenwashing" or "green marketing", which involve no real commitment to research and development of goods and services which use less energy or consume fewer resources (Laufer, 2003)[7].

An organisation may seek to co-evolve with ecosystems in the design and manufacture of its products through life-cycle assessments. Yet, *we cannot speak of its co-evolution with biodiversity* if it adopts the Carbon dioxide equivalent (CDE) as the leading indicator for arbitrage or decision-making. A view of the economy which treats biodiversity as a mere "natural resource"[8] to be traded does not grasp the essence of the evolutionary properties of life. It sets *human beings outside* and *above* the diversity of living systems. Similarly, to reduce the economy to the exchange of materials, energy and information[9],

(5) Meaning all ecosystem services (Millennium Ecosystem Assessment, 2005).
(6) According to Marcel Mauss (1922), a gift is never « free » but obligates the recipient to reciprocate. It gives rise to exchanges and creates or maintains social ties. The gift is an essential feature of human society, and has three components: the obligation to give, the obligation to receive and the obligation to give back. It can be compared to other types of exchange, such as bartering and selling.
(7) According to a British study, « Assure View » (www.corporateregister.com), three-quarters of the CSR reports published world-wide in 2008 were not verified by any independent organisation. In France, an assessment published by the *Observatoire sur la responsabilité sociale des entreprises* (www.orse.org) confirms that the accessibility and verifiability of the data are particularly problematic for many businesses.
(8) On this view biodiversity would be treated on the same level as fossil resources such as petroleum or gas, which are only renewable on a geological time scale.
(9) As do Passet (1979) and the systems ecology developed by Odum (1983; 1996).

with industrial systems operating as sub-components of the biosphere, is to reduce biodiversity to a static parameter[10].

It is crucial to recognise the nature of the interactions between businesses and the diversity of living systems. *Businesses are not intrinsically hostile to living organisms, in fact far from it.* ***Some species,*** which provide direct monetary or cultural benefits, ***have been selected by humans for millennia,*** and thus can be said to have co-evolved with them: we need only mention the growing of crops, the breeding of farm animals, the keeping of domestic animals and even the organisms that live in or around our homes (mice, sparrows). These organisms have adapted to our selective pressures and in turn affect our choices and ways of life. The overt or unconscious motivation for these selective dynamics of co-evolution (which has led to the competitive exclusion of a myriad other species over increasingly wide areas) seems to be the **necessary control over** the **unforeseen,** the **variability** and the **complexity** associated with ecosystems and biodiversity, in order to produce more, live better and thus meet our "needs".

Make no mistake about it: the greatest danger lies in elevating uniformity to the status of a universal model. First we summon up fear and suspicion, and then we throw out the baby with the bath-water.

Robert Barbault (1994, p. 300)

(10) "I refuse to see ecology reduced to a mere parameter. Ecology determines the continuation or cessation of life. Yet the 'Grenelle' wants to treat it as one issue among others." Pierre Rabhi, *Terre Sauvage* 236, March 2008, 92-95.

3.1.3

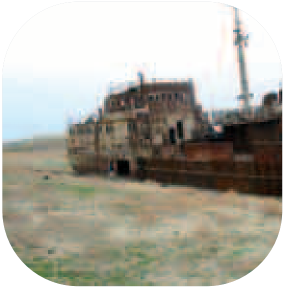
Yet, this quest for absolute control, for the optimisation of transformation processes of materials, whether derived from living systems or not, is the outcome of social choices based on value systems[11]. Weber and Lateltin (2004) observe that industrialisation today undermines biological diversity by simplifying and impoverishing ecosystems. Businesses and all their stakeholders, including consumers and governments, are thus **responsible for globalising the homogenisation of living systems.** ***Contemporary*** *technological, organisational and institutional innovation is elevating* ***uniformity*** to the status of an ***absolute, universal model,*** thus inexorably reducing the variability, diversity and complexity of living systems (Barbault, 1994; Weber, 1996). The "biological roulettes", randomness-generating mechanisms which operate at all levels, from biological systems to ecological ones, are rejected, over-simplified and even obliterated outright. "Modern" agricultural practices have effectively replaced complex ecological processes with factors of production supplied by agri-business: chemical inputs and patented seed varieties, intended for a single model of agricultural development - monocultures with ever-increasing output. These monocultures mean the concomitant erosion of biodiversity, the loss of agro-systems' capacity to self-organise and self-regulate (Larrère, 2002) and, often, the loss of food sovereignty by the most fragile populations. This example is useful because easy to understand, but it is not an isolated one. Questions need to be asked about **all the choices** and **models of development** (and of ecosystem use), including those related to biotechnology (Weber and Lateltin, 2004). To what extent have the *biological roulettes, the drivers of spontaneous diversification*, been altered by genetic manipulation? If these techniques become widespread, what will be the long-term evolutionary consequences (Pavé, 2007)?

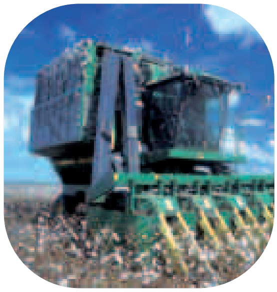
Cloning in particular, while a necessary process for many micro-organisms and a common one in the plant kingdom, has biological limits, and poses a significant risk of genetic erosion in higher organisms by eliminating the shuffling and mixing of genomes associated with sexual reproduction. Other types of genetic manipulation can induce massive change in the mechanisms that regulate gene expression. These can seek *to prevent an organism from reproducing,* a basic function of all living systems, as in the case of GURT[12] seeds which some seed suppliers try to force farmers to buy every year so as to guarantee a sustainable income (seeds harvested are sterile). Another example is the virtual disappearance of the Aral Sea because of *development choices based on uniform land use, optimal only at a given moment,* which failed to take into account the dynamics of interactions between ecosystems and socio-economic systems in co-evolution. A "green revolution" based on cotton monoculture was adopted, leading to an increased need of fertiliser, pesticides and water, which in turn led to the building of hydroelectric dams, which inexorably led to the widespread - *and possibly irreversible* - degradation of watersheds and aquatic ecosystems. Negative outcomes for the human populations which depend on these systems in their daily lives have since emerged, both with respect to the availability of renewable resources, illustrated by the demise of the fishing industry, and to public health, with an explosion in infant mortality rates caused by agricultural and industrial pollution.

(11) Value systems are systems for classifying the universe, objects, beings and the relations between beings and objects. According to anthropologist Mary Douglas (1966), what is not in its proper place is dirty. Poppies are "dirty" from the point of view of the farmer who seeks "to separate the wheat from the chaff": they do not belong in his wheat field, and he would be baffled by the tourists who stop admiringly to photograph them.

(12) Genetic Use Restriction Technologies: http://www.cbd.int/programmes/areas/agro/gurts.aspx

3.1 UNDERSTANDING THE INFLUENCE OF BUSINESSES ON THE EVOLUTION OF LIVING SYSTEMS



Can we rethink the interactions between businesses and the diversity of living systems of which we form a part? What strategic implications for businesses would result? What approach or model of development could be promoted by all, businesses, local governments, consumers, scientists and NGOs? What co-evolutionary logic could be chosen to develop mutualistic evolutionary dynamics between biodiversity and networks of businesses? *This amounts to asking how can profits be used to diversify living systems, and how can biodiversity become a source of increased profits!*

3.2 GOODS AND SERVICES FOR THE CO-VIABILITY OF BIODIVERSITY AND BUSINESSES

3.2

What decisions should we make today to avoid the consequences of biodiversity loss for future generations? How should we understand the interactions between the precautionary principle, risk prevention and free enterprise? In other words, what models of development and constructive partnerships can we propose to businesses that will enable us to face today's challenges together? *We seek a new model for the co-evolution of businesses and ecosystems*, and we call it the **"co-viability of biodiversity and businesses".** The aim is to reintegrate human beings, businesses and the global economy into the diversity of living systems. From the anthropological perspective of our mutual debts to the latter, we propose to overturn the uniformity model and to build together a new model of development based on the **growth and globalisation of the diversity of living systems.** This amounts to enhancing, at the heart of technological, organisational and institutional innovation, the biological roulettes which underpin the evolutionary dynamics of human beings and the living systems which they depend on and form part of within the biosphere. This may seem like a particularly risky bet - but just think of the return on investment if it succeeds!

3.2.1 Beyond the arbitrary opposition of competitiveness and ecology

Risk analysis - the assessment of the uncertainty, frequency or probability of an event and its severity - is central to social controversy and economic activity. Businesses see environmental problems as key strategic issues and CSR (Corporate social responsibility) approaches are becoming commonplace (*The Economist*, 2008); the **social perceptions** of industrial operations **underpinning their legitimacy.** Research into strategy and economics has been focused for some time on businesses' responses to social and institutional pressures (Freeman, 1984; Schuman, 1995), with the publication of a large number of articles bearing on businesses' attitude to environmental issues and the development of several typologies of behaviour (Hart, 1995; Jolly, 1993; Martinet and Reynaud, 2000; Persais, 1998).

TABLE 4: MATRIX OF THE DYNAMICS OF COMPROMISE, FROM MÉTROT (2005)

		Business risk / opportunity ratio	
		Unfavourable	**Favourable**
Stakeholders' power, legitimacy and ability to act	**Weak**	**Stonewalling scenario** Compromise poorly constructed or sought Mimetic behaviour *Example: Code of conduct with no audit or training mechanism, sponsorship*	**Pro-active policy** Compromise focused chiefly on compliance with standards, seeking to activate passive costs *Example: disabled access policies, energy saving policies*
	Strong	**Reactive policy** Compromise focusing heavily on self-justification in response to criticism *Example: procedural measures, certification and public relations ("greenwashing")*	**Win-win contract** Compromise firmly focused on change (research and innovation); it may be a major element in strategic policy *Example: industrial ecology, fair trade*

In the debates in which "taking the environment into account" is opposed to "making businesses competitive", two approaches have been distinguishable, especially since the emergence of the concept of sustainable development in the 1980s. On the one hand, a "win-lose" perspective holds that, given the growth of social and regulatory pressures, businesses can no longer continue to ignore the negative externalities of their operations without risking the loss of their legitimacy or right to operate (Boiral and Jolly, 1992). Their resulting environmental expenditures, seen as proportional to the degree of public pressure they face, cannot easily be avoided, and are argued to greatly exceed the environmental benefits to the community. Environmental concerns, imposed via regulations or industry standards, are thus equated with external constraints on the business which require loss-making investments, not to mention a reduction in productivity (Walley and Whitehead, 1994). In their efforts to meet these environmental targets, businesses perform **cost-benefit analyses** in order to calculate optimal pollution levels[13], using efficiency criteria rather than ones concerned with environmental efficacy.

By contrast, in the "win-win" approach, otherwise known as the Porter hypothesis, the focus is on the benefits of environmental actions initiated by businesses, in order to demonstrate that there is no direct causal relationship between loss of competitiveness and the internalisation of negative environmental externalities (Porter and Van der Linde, 1995). These benefits include reduced energy and raw materials consumption, access to new markets, technological innovation and enhancement of the company's reputation. Empirical studies since the 1990s have produced conflicting results, some supporting the Porter hypothesis (Shrivastava, 1995; Lanoie and Tanguay, 1999), while others have confirmed a correlation between loss of competitiveness and environment-related expenditures (Boyd and McClelland, 1999). Boiral (2005) argues that the ***origin of the controversy*** lies both in the ***complexity of environmental problems*** and the ***arbitrariness of cost-benefit analyses.*** The integration of environmental problems into corporate strategies involves at least four co-evolving factors, which would vary depending on the specificities of each industrial site or business.

1. The role of industrial and business excellence in environmental performance

Environmental initiatives are often inseparable from the normal routines, methods and organisation of the workplace designed to improve productivity and competitiveness (Shrivastava, 1995); for example designing a car assembly line to be less energy-intensive. Some investors view a business's pro-environment policies and initiatives as indicators of sound management, making that business a safe investment.

(13) This calls for "putting a price" on the "value" of the environment, of biodiversity as a whole or on ecosystem services. This is done via off-market assessment techniques which have serious methodological limitations, for example contingent assessments in which protocols cannot be replicated or results compared either geographically or temporally (Bonnieux, 1998; Weber, 2002a). In spite of the efforts of economists, biodiversity is essentially irreducible to the categories of "goods", "services" and "capital" (Dasgupta, 2001; Heal, 1998).

3.2.1

2. The distinction between preventive and corrective action

Corrective action corresponds to measures undertaken after opening an industrial plant, such as process redesign to control or reduce pollution. Research supporting the "win-lose" hypothesis is typically based on comparative analysis of this type of investment (water pollution remediation systems, particulate filters), because it relies on parameters (environmental costs) which can easily be isolated. Preventive action, in contrast, refers to technical and organisational innovations integrated into production methods before the start of their life cycle, at the initial design stage. They are often indistinguishable from measures aimed at improved productivity and efficiency. While corrective action generally requires expensive investment with a minimal increase in profitability or competitiveness, preventive action can be both economically and environmentally attractive, and thus an advantageous alternative, depending on the activity or business in question (Boiral, 2005).

3. Marginal decrease in the effectiveness of environmental actions

The costs and efficiency of environmental action, whether preventive or corrective, depend directly on the level of pollution remediation projected by the business. Beyond certain thresholds, the costs can turn out to be quite prohibitive (Salamitou, 1989), while the results can be uncertain, particularly in the case of diffuse pollution generated by many different polluters. This partly explains the cautious attitude of companies involved in environmental management systems, especially those with ISO 14001 certification (Boiral, 2004): continuous improvement efforts are easy to implement and promote when initial environmental performance is modest, or when the associated targets and indicators do not call into question the legitimacy of these efforts.

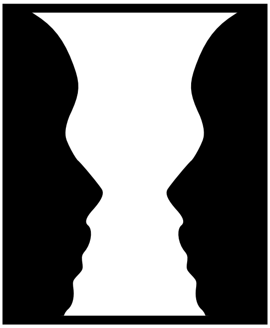
4. Duration of asset engagement

Anticipating future regulatory requirements is a key challenge for businesses which hope to avoid additional costs at the point when these requirements become law. This is even truer in the case of asset specificity. An asset is said to be specific when its use-value would be lower in uses other than that for which it is intended in the initial investment (Williamson, 1981). An asset is highly specific when it cannot be converted to other uses without imposing a significant loss of productive value on its holder. Riordan and Williamson (1985) argue that there are five categories of specific assets: (a) localised assets which cannot be reused elsewhere without incurring high costs, because of the necessary proximity of production operations, (b) physical assets, such as equipment designed for a specific type of production and not reusable elsewhere, (c) intangible assets which reflect emotional attachments, such as customer loyalty, (d) human resources with specific expertise gained in the course of doing work and (e) dedicated assets which are in principle transferable but for which there is no demand apart from the transaction that led to their acquisition. According to Godard and Hommel (2001), the **specificity of assets limits the options for re-deploying them.** Specific assets cannot be resold or reassigned to other activities without loss, over the entire period of a business's engagement. We may note that there is a continuum of levels of asset engagement. At one end, the absence of sunk costs allows for an engagement that is reversible at will, in the short term, in a perfectly contestable market. At the other end, the business is engaged "for all time" in markets which are not fully contestable owing to the presence of sunk costs. Godard and Hommel (2001) argue that the irreversibility of the engagement attributable to the presence of exit costs can be relativised, regardless of a business's date of entry into the market.

There is clearly a need *to get beyond the arbitrariness of the debates which rely on an opposition between competitiveness and environmental*

issues. The impact of environmental policies on businesses' competitiveness depends in part on the specifics of each situation, economic sector or business, from the type of pro-environment efforts initiated to the length of the period of asset engagement. However, a consideration thus far unexplored is the **dependence of cost-benefit analyses on the modes of regulation, incentives and property rights in force.** If sources of pollution fall under clearly established property rights, it is socially optimal to make the polluter pay. Similarly, if a premium is put on deforestation combined with the growing of export crops, it is understandable that refraining from exploiting a tropical forest so as to convert it to a monoculture is equivalent to the incurring of an opportunity cost for the business in question.

3.2.2 Towards an understanding of biodiversity as dynamic and evolutionary



Taking biodiversity into account via a "stakeholder management" approach is of only limited value. Semal (2006) shows that this approach does not allow for the impartial accommodation of stakeholders' demands: in reality, it is based on the "legitimised" exclusion of the weakest among them. A form of environmental management which explicitly accords the status of stakeholder to the natural environment, as proposed by Starik (1995), is also not a solution, as long as there is no concern for the way businesses perceive living systems and its implications for their management and ownership. What implications does the diversity of ways of viewing "nature" have for the interactions between businesses and biodiversity? Although the latter is more and more often viewed as a standard for managing protected areas, forests and fisheries as well as open spaces and industrial parks in some towns and cities, more detailed analysis shows that the policies and practices of economic agents are diverse and constantly evolving (Selmi, 2006). Holling, Gunderson and Ludwig (2002)[14] have devised a chart showing the five myths or caricatures of "nature", and their implications for ecosystem management (Table 5).

TABLE 5: PERCEPTIONS OF NATURE AND THEIR IMPLICATIONS FOR THE MANAGEMENT OF BIODIVERSITY (HOLLING, *ET AL.*, 2002, P. 12)

	Stability	Processes	Policies	Consequences
Flat Nature	None	Stochastic	Random	Trial and error
Balanced nature	Globally stable	Negative feedback	Optimise or return to equilibrium	Pathology of surprise
Anarchic nature	Globally unstable	Positive feedback	Precautionary principle	Status quo
Resilient nature	Multiple stable states	Exogenous input and internal feedback	Maintain variability	Recovery at local scales or adaptation ; structural surprise
Evolving nature	Shifting stability landscape	Multiple scales and discontinuous structures	Flexible et actively adaptive, probing	Active learning and new institutions

(14) The work in question, Panarchy, is a paradigmatic contribution to research on sustainability: it was the primary conceptual source for the Millennium Ecosystem Assessment (2005).

"Flat Nature" was a concept widely shared by organisations up to the end of the twentieth century. Ecosystems were viewed as infinitely malleable and amenable to control by human beings, who have the ability to make rational judgements, foresee the future accurately and make optimal choices. Technological innovation was seen as a panacea.

"Balanced nature" is a concept popular among businesses with a CSR approach: the *balance of nature* is to be maintained by exploiting natural resources *sustainably*, a notion which refers implicitly to the optimal extraction rate (Hotelling, 1931). This notion presupposes that the environment is constant and the Earth has a fixed carrying capacity for humans and all other living organisms. *"Development which meets the needs of the present generation without compromising the capacity of future generations to meet their needs"* relies on the notion of balance and sustained yield. This sustainable development, based on an idea of nature as a stock to be managed optimally, leads inexorably to hair-splitting distinctions between "strong" and "weak" sustainability, depending on which discount rate is adopted (Godard, 1995). This is why we need to remember the **failure of the Biosphere 2 project**[15], whose goal was to reconstitute the ecological conditions necessary for the survival of the human species on another planet: beyond the refutation of the hypothesis of perfect substitutability between physical capital and natural capital[16], it was *our inability to recreate artificially the complexity of ecosystem interactions underlying the dynamics of living systems* (and consequently of the economy) which was brought to the fore (Levrel, 2007).

Contemporary research on systems dynamics suggests that there can be only fleeting equilibria in nature and in the economy (Weber, *et al.* 1990; Aubin, 1992; Cury and Roy, 1991). As Weber (1996) emphasises, *"the intrusion of variability, uncertainty and irreversibility in systems dynamics brings up the question of development with respect to the management of the interactions between socio-economic variability and natural variability, both spatially and temporally...* **To think of a viable model of development over the long term** *amounts to envisaging the improved management of the interactions between the various sources of variability, both natural and social, based on very long-term goals."* Nature, complex, dynamic and evolving, gives pride of place to variability, change and diversity as insurance policies for the functioning and evolution of the living systems to which we belong. We need **to move on from assessing sustainable exploitation levels** (Balanced nature) and **work on understanding the dynamics of the interactions between resources and their users.** This is the perspective on which our proposed model for the co-evolution of businesses and ecosystems is based: we refer to it as the co-viability of biodiversity and businesses.

(15) Biosphere 2, named after the first biosphere, the Earth, is a huge sealed dome situated in Oracle in the Arizona desert, built between 1987 and 1991. It includes a rainforest, a savannah, a mangrove swamp, a desert, agricultural fields, inhabited buildings and workplaces. The project sought to assess the feasibility of building a viable artificial ecosystem for the colonization of outer space. Two experimental sequences were performed in the sealed dome. The first lasted from 26 September 1991 to 26 September 1993, the second for six months in 1994. Although both failed, chiefly because of oxygen recycling problems, the project was valuable as a sign of our inability (1) to build a viable ecosystem and (2) to control its evolution in order to ensure the survival of the humans living in it. For more information, see http://www.biospheres.com/

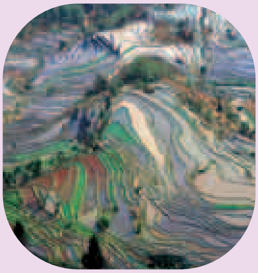
(16) This hypothesis relates to the notion of "weak" sustainability.

3.2.2

BOX 9: A "DOUBLY GREEN" REVOLUTION IN AGRICULTURE?

Although the "green revolution" has contributed significantly to increasing crop yields, in particular through intensive techniques and the use of inorganic soil amendments, this mode of production has brought the widespread degradation of agricultural systems, the most visible consequences being soil erosion and water pollution (Griffon, 2006). From the control of the complexity of living systems and the circumventing of climatic events to the standardising of cultivation practices, agriculture today contributes inexorably to the homogenisation of living systems. Even although the homogenisation of agro-systems boosts production in the short term, it exposes crops to pests and pathogens and increases dependence on chemicals. Homogenising agricultural systems means endangering our collective **insurance policy** in the face of the variability and uncertainty associated with changing markets and ecosystems (Di Falco and Perrings, 2005; Birol, *et al.*, 2005; Heal, *et al.*, 2004).

In a world where agriculture is massively globalised, tiny evolutionary adaptations can have major consequences (Barbault, 2006). A microscopic insect or fungus can take advantage of a mutation to become a "long-range missile", threatening many areas of the world in which it was once completely unknown, as in the case of the sweet potato whitefly. Another unpleasant surprise for farmers who have become dependent on commercial herbicides is the emergence of cross-resistance in "weeds". These "unwanted" plants evolve in order to circumvent the chemical attacks on key elements of their metabolism, and, as a result, any other herbicide directed at the same target will also be ineffective, whatever its chemical composition. These phenomena of co-evolution of agricultural practices and crop pests are equivalent to an arms race(17): modern agricultural techniques have simply speeded up the evolutionary dynamics of pest species. Similar interactions are to be found in resistance to antibiotics, a real scourge for "modern" medicine which too often ignores the ecology of living systems.

(17) Co-evolution amounts to all the *running* one could do just to *stay* in the same *place:* Van Valen has called it the "Red Queen" model after the Lewis Carroll character, Alice. Each species growing in a field, for example, is caught up in a constant race to preserve its ecological niche and save itself from disappearing.

Moreover, the spread of "biotechnologies" generates a great deal of controversy within the agricultural sector, alarmed by the reorganising of production methods and especially by the significant increase in farmers' dependence on their suppliers (Godard and Hommel, 2001). These suppliers produce both seeds and inputs, marketing and selling seeds which are resistant only to their own herbicides, thus creating captive markets and making it disadvantageous, if not impossible, to grow different seeds close together. In the present state of expertise, in which transgenic seeds are not being compared to traditional ones, it is impossible to confirm or refute the potential benefits which might result from the adoption of these technologies. Nonetheless, the dual challenge - to food production and to biodiversity conservation - does not arise at the level of technological choices but rather at that of the social choices and models of development which underlie them. What are the total benefits and costs for consumers, for the world's countries and for their populations? GMOs are neither good nor bad in an absolute sense, but they can be used for good or ill; hence the importance of regulating genetic engineering both in individual countries and across borders (controlling their expansion), as well as of technology transfer from rich countries, to enable poor ones to take an active part in this major technological breakthrough (Weber, 2002b). Controversies over GMOs have to do with their social acceptability: many people refuse to buy agricultural GMO products but are willing to pay for research on medical GMOs out of their own pockets (Telethon). Reinsurance companies, however, assign a probability of 1 to the occurrence of health risks associated with GMOs (the use of viral vectors to modify the human genome)[18].

The goal of a "doubly green" revolution (Griffon and Weber, 1996; Griffon, 2006) is not to achieve the best yields under optimal conditions, but to seek a satisfactory return at a lesser economic and ecological cost. This revolution will come about through an increase in crop diversity, the abandonment of ploughing associated with seed sowing directly underneath cover crops and the enrichment of biodiversity in individual fields and across whole landscapes; especially via market mechanisms such as payments for ecosystem services (FAO, 2007) and the reform of conventional tax incentives associated with farming. It is time to adapt and rethink the methods of production, the processing sectors and the design of products[19], for example so as to harvest and process heterogeneous crops grown in the same field.

(18) The probability of an event is represented by a number between 0 and 1. An event which is impossible has a probability of 0 and one which is certain has a probability of 1.

(19) Marketing to and educating consumers accustomed to standardised products available anywhere year-round needs to be rethought.

3.2.2

BOX 10: WHAT MODEL OF DEVELOPMENT WILL ACCOMMODATE THE GROWING DEMAND FOR FISH AND SEAFOOD?

In 2004, fishing accounted for almost 106 million tonnes of resources, 43% of it derived from aquaculture (FAO, 2006). These figures are rising steadily because of the inexhaustible demand for fish and seafood. Today, **almost all fisheries** in which there is *free access to resources* **have met or exceeded their renewal threshold.** This situation is particularly problematic for the functioning of marine ecosystems, as irreversible changes are taking place in the composition of benthic and pelagic communities and, therefore, in trophic networks: this cannot coexist with the long-term management of marine resources. Yet, solutions do exist, such as the use of individual (preferably) transferable quotas (Revéret and Weber, 2007). But these solutions meet with the reluctance of economic agents and emerging awareness on the part of consumers, not to mention the lack of political will.

Faced with declining stocks and rising demand, ***the food industry is now turning to fish farming,*** a mode of production which targets only a limited number of species. Fish farming is spreading rapidly in coastal waters and coastal zones around the world. However, it causes a number of problems[20], including:

- The destruction of mangrove swamps, which are particularly important for protecting coastlines against severe weather (tsunamis) and for the viability of the fisheries themselves (nursery grounds), as in the case of shrimp aquaculture in Madagascar and south-east Asia;
- The release of large quantities of organic waste, sometimes causing pollution and loss of benthic biodiversity in the waters adjacent to fish farms: these effluents are composed of fish excrement and excess food in the farmed water (this food is often fishmeal made from wild fish, which speeds up the depletion of their stocks);
- The use of significant quantities of inorganic matter essential for the "health" of the farmed stocks, such as antibiotics used to combat parasites which spread quickly in the overcrowded floating cages;
- The growth of unintended cross-breeding between wild and farmed fish species (individual escapes), with consequences for the viability of the wild stocks which most often remain to be assessed and monitored over the medium to long term (salmon farms in Norway).

(20) http://www.radio-canada.ca/actualite/decouverte/reportages/2003/01-2003/2003_jan19/aquaculture.html

In parallel with land-based agro-systems, *thanks to the green revolution*, we are now witnessing a **gradual homogenisation of marine ecosystems.** Would it not be preferable to speed up the pace of technological, organisational and institutional innovation in favour of diversified, productive and resilient marine ecosystems? Beyond the drastic reduction of waste by the fishing industry (indiscriminate catch methods) and by the commercial fish processing industry, this alternative would lead to the **"gardening of marine spaces"** through:

- *Zoning systems*, both *efficiently regulated* and *adaptive*, for *controlling access and uses;*
- *Pioneering ecological engineering* via the establishment and management over the long term of *artificial reefs rich in biodiversity.*

3.2.3 Fundamentals of a co-viability framework for biodiversity and business

A rational individual or group is one which pursues coherent goals and implements appropriate measures to achieve those goals.
Maurice Allais, 1959
Winner of the Nobel Prize for Economics.

The management of "natural resources" is not the same thing as that of renewable resources such as biodiversity, water or the atmosphere (Weber, 2002b). Sustaining a mining activity, for example, really amounts to postponing the eventual exhaustion of the mine. For biodiversity, as for any other renewable resource, the problem is: *what* ***mode of co-ordination*** *is possible among the users, given the* ***dual requirement*** *of the* ***viability of the resource*** *and the* ***profitability of the operations?*** It is possible to go on extracting renewable resources "forever", as long as the quantity extracted is not greater than that necessary for its renewal (notwithstanding climate change). In other words, the *cost-benefit analyses to take account of biodiversity within businesses strategies* are closely related to *access, use and property rights.*

To address the management of resources in terms of land rights can lead to confusion between *ownership of the land itself* and of the *rights to the resources it contains.* A variety of property rights exist, from the traditional (private and public property rights) to the more complex (rights of access and use). Here we will speak of appropriation, of which land ownership is only one form and private property a very special case. The possibilities are as follows (Weber and Trommetter, 2003):

- **Non-existence of property rights and of access rights:** this leads to the *degradation of resources* and to *economic disaster.* As long as profits can be made, more people will show up to exploit the resource. This is what Hardin (1968) incorrectly named the "tragedy of the commons"; in reality it is the "tragedy of free access" (Weber and Revéret, 1993), since common property rights prohibit free access;
- **Common property rights,** including defined access rights and / or rights of use by the community in question: this system encompasses interpersonal relationships and the different types of relation between human beings and ecological systems, from trade to relationships based on the "sacred";
- **Propriété publique :** l'Etat décide des droits d'accès ou d'usage qu'il attribue ou non, ainsi que de leurs modalités et durée (sous-sol, ressources génétiques);
- **Public property:** the state authorises or denies access and use rights, as well as their terms and duration (such as underground or genetic resources).

Today the globalisation of trade and of production models determines the evolution of biodiversity (Trommetter, 2005; Weber and Lateltin, 2004). For any elements of biodiversity which possess market value, squandering, excessive exploitation and overinvestment will occur if access is not restricted and controlled. Fishing in international waters is a perfect example of this. To ensure the viability of ecosystems and biodiversity, a **primary goal** is the **elimination of situations of free access to resources,** *regardless of the regime of property rights in place.* Businesses have a fundamental role to play to that end, both at the level of the land they own and exploit and that of the ecosystems from which they derive ecosystem services (raw materials, biotechnology).

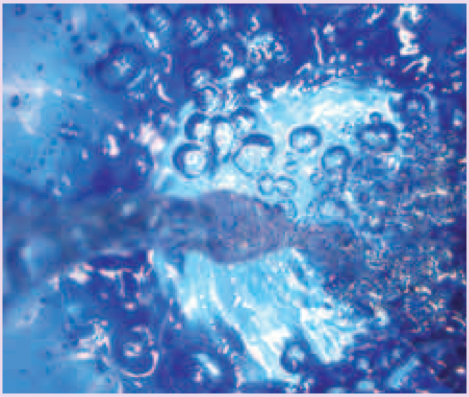
BOX 11: BOTTLED WATER PRODUCTION: CO-ORDINATION OF ECONOMIC AGENTS AND PAYING FOR ECOSYSTEM SERVICES

To manage the risk of nitrate contamination of the aquifers supplying its bottling factory in north-eastern France, Vittel (Nestle Waters) has spent the equivalent of 8 million euros since the late 1980s. This expenditure covered the purchase of some 300 hectares of land around the mineral springs and signing 20- to 30-year contracts with local farmers, who made a commitment to agricultural practices guaranteeing good water quality (Barbault, 2006). The latter mode of co-ordination of the economic agents involved, driven by private-sector entities, is equivalent to a system of **payment for ecosystem services** (PES). It could be replicated in many similar situations both in France and abroad, particularly in situations (Perrot-Maître, 2006) where:

- It is especially expensive, impossible or socially undesirable, to acquire the land needed for the management of risks associated with a particular land use or mode of production;
- There is a high risk of significant additional costs for pollution remediation;
- The links between ecosystem health and economic activities are clearly identified and understood;
- Expected benefits are high enough to justify the implementation of such a system.

According to the WWF (2007), several models exist for incorporating ecosystem services into the economy:

- PES are used to reduce the production costs of products or services, as in Vittel's case;
- Consumers will pay a premium for goods and services associated with production methods which protect or restore ecosystems, as in the case of organic farming and eco-tourism;
- Combining market mechanisms with regulation mechanisms, as in the case of mitigation banking (compensation for ecological damages) and carbon trading (negotiable emission permits);
- Businesses can support ecosystem services by voluntary spending, such as corporate sponsorship of the management of protected spaces;
- Ecosystem services can be sold to governments, as in the case of payments for hydrological services in Costa Rica and the reform of the European Union's Common Agricultural Policy (CAP) to encourage more eco-friendly farming.



3.2.3

Regimes of property rights must be **precisely defined** and cannot be reduced to private property or state property. In effect, private property cannot guarantee the viability of renewable resources. It is liable to lead to their wanton destruction, especially if capital is mobile, as in the case of the fencing in of land, a practice which has disrupted many mammals' migration routes all over the world, for instance in the USA and South Africa. After all, in which world are we living in if not that of global finance? Insofar as rights of access and use have become independent of property rights on goods (resources), using markets for trading property rights may be enormously flexible and adaptable. According to Weber (2002), *"patents, which are temporary monopolies on access and use, do not constitute "ownership rights". You cannot own genes, but only acquire a monopoly on the access and use of them. Living systems thus cannot be "appropriated", but markets can be developed for the trading of rights of access and use."* When globalisation is confronted by such a diverse and complex range of property rights, transaction costs can be reduced by trading certain elements of property without laying a hand on property itself.

However, the growth of markets of property rights is not a reason to be optimistic about opportunities for the poor to regain control of their lives. If markets of property rights were to expand to cover the management of biodiversity, on the model of intellectual property rights and projected use rights markets, this would have a major impact in developing countries (Weber, 2002b). Depending on how they were regulated, these markets could either *strengthen rural communities* or, much more probably, *marginalise them further through the hoarding of rights by those in power,* whether politicians, customary chiefs or private organisations. The scientific issues around biodiversity are in fact also social, economic and political issues. Recognising that very varied regimes of appropriation do exist, by guaranteeing rights to temporary or permanent access and use, is one of the surest ways to fight poverty. It as a prerequisite for local governance models which are socially equitable by giving local communities the opportunity **to regain possession of their present** and **engage themselves in the future.** According to Weber (personal communication, 2008), nine steps are needed to negotiate an effective and equitable management system:

1. **Setting qualitative and quantitative goals;**
2. **Identifying and involving stakeholders:** that is, all those affected by the projected management system as well as those directly involved, who will play an active role;
3. **Reaching agreement on the initial situation:** each person's role and responsibilities, the current issues and future trends;
4. **Selecting management instruments:** where there is no contract, market mechanism or regulatory institution, the decisions of one resource user may harm others without any compensation being due. This externality has to be internalised by developing mechanisms and institutions through which compensation is made possible and the costs of harm managed by the resource users themselves. This can take the form of complementary economic instruments, such as taxes, quotas, low-interest loans, permits, transferable permits, property rights or property rights markets. For example, the OECD (1999) has discussed at length the equitable sharing of benefits from genetic resources: its group of experts has shown that the sharing of benefits and access issues can be tackled simultaneously, via contracts and property rights markets. An "appropriate definition" of property rights - collective, public or private as needed - is essential for equitable benefit sharing;

5. **Initial distributing of rights:** taking into account the history of rights in order to define rules of equity and calculation principles;
6. **Monitoring of the management system:** who is in charge of monitoring, using what means and on what cost-sharing principle?
7. **Controlling:** who controls the proper application of the rules, at what cost and from what income source?
8. **Imposing sanctions,** with separation of powers between executive and administration: who designs and decides on sanctions? Who manages their application?
9. **Evolution of the management system:** procedures for changing the system, as needed, must be established at its initial stage of design. It would start with the review of its goals (cycling back to step one).

"All positions and instruments are equally defensible, but their real value can only be measured in terms of the ways they are implemented in a given situation, subject to given conditions of evolution" (Weber, 1996). A decision is the result of an interaction process between agents whose perceptions and powers vary during negotiation (Weber and Bailly, 1993). A **second goal** for businesses is thus to give themselves the means to produce positive externalities at both local and global levels: they need to **participate actively** in the development of **efficient and socially equitable management systems,** on a scale appropriate to every issue at hand. They should eschew any strategy devised merely to circumvent problems, such as the Clean Development Mechanism (CDM) and carbon sinks[21] presented in the Kyoto Protocol, or the race to desalinate seawater to solve water shortages[22]. In this way, technological, organisational and institutional innovations could lead to the appropriate local management of ecosystems, without causing irreversible consequences at a global scale (Trommetter, 2008). The related modes of appropriation could be assessed via complementary criteria (Weber and Revéret, 1993): (1) perceptions, (2) alternative uses of resources, (3) ways of accessing and controlling access to resources, (4) ways of transferring resources and profits derived from these resources, though not exclusively in monetary terms, (5) ways of allocating or sharing resources and / or the products derived from them. Businesses would *be required to understand the ecological and social consequences* of:

- Each of the property rights (access, use, resource, land) relative to biodiversity which they own or control;
- Each of their business and appropriation strategies associated with living systems.

(21) These include monocultures of fast-growing trees after clear-cutting of virgin forest, or the adding of micrometre-sized iron particles to seawater to speed up carbon sequestration by plankton.
(22) Beyond the not insignificant impact of desalination on ecosystems, this approach postpones the necessary collective, transparent and socially equitable management of watersheds and associated water resources.

3.2.3

What **simple rules,** underpinning the co-ordination between the economic agents involved, can be devised **to manage the complexity and uncertainty inherent in biodiversity?** Adopting a dynamic and evolving concept of biodiversity leads to a *viable model of development* in the sense proposed by Weber (1996): the real challenge lies in the collective choice of long-term goals for *each organisational level of living systems* (genes, species, habitats, ecosystems, biosphere) and *their interactions.* These choices must be made before constructing the databases needed for understanding and analysing dynamics and trends (Alfsen and Greaker, 2007). Making these choices means asking what forms of biodiversity we want in the areas of the world we use, on which we depend and which affect our ways of life. To insure ourselves against uncertainty and preserve our future, we must **choose "living ecosystems",** hence **diversified ones.** We cannot pat ourselves on the back for the islands of protected areas, currently rich in biodiversity, which we have created: these are lost amid oceans of ecological uniformity and are doomed to be destroyed by global climate change and the absence of national and international ecological networks.

We thus propose a new model of co-evolution between businesses and ecosystems, a system of values with the potential to be widely shared: the **long-term co-viability between businesses and the diversity of living systems.** This model would govern the dynamics of interactions between the precautionary principle, risk prevention and free enterprise. For all goods, services and activities, it would amount to define:

1. The **dynamics of interactions between socio-economic and ecological systems,** at all relevant levels. The development of a business's operations is determined especially by the duration of engagement of its assets and the existing systems of regulation of economic activity. From the perspective of living systems, variability rhythms differ depending on the object of study: an organism (or a community) modifies the habitat it inhabits, and adapts to changes to that habitat due to exogenous factors, following a "viability path" in which equilibrium and optima exist only instantly (Aubin, 1992). The viability path will be different for the ecosystem as a whole, but still closely linked to those of its component parts.
2. The **co-viability constraints for these dynamics,** in the context of the co-evolution of businesses and the diversity of living systems. As Weber (1996) underlines, *"the viability of human communities and that of the nearby or remote ecosystems from which they draw their livelihoods determine each other reciprocally, but not exclusively. Economic and social choices need to be taken under the constraint of maintaining ecosystem viability, in the same way that decisions about ecosystem use or modification should be made under the constraint of maintaining the viability of ways of life."* These co-viability constraints for biodiversity, human populations and businesses would underpin the regimes of co-ordination, or management systems, which are to govern relations between socio-economic and ecological systems in co-evolution.

The co-viability of biodiversity and businesses, from the logic *of mutualistic indebtedness*, would be further based on:

- The joint construction of a new model of development based on the *increase*, the *globalisation* of the *diversity of living systems*. This means that **technological, organisational and institutional innovation must focus and promote the "biological roulettes"**[23] which determine the evolutionary dynamics of human beings and the living systems they depend on and form part of. This model would be based on the reversal of the uniformity model now dominant in the production of goods and services and would in effect create *social ties with the living world,* in which variability, change and diversity would be seen as insurance policies.
- The **globalisation of the diversity of living systems** as **the standard governing the management of all marine and terrestrial ecosystems,** whether **urban, agricultural, rural** or **wild.**
- The promotion and, in due course, the widespread expansion of mechanisms of mutualistic relations between businesses and biodiversity, particularly with respect to sale, procurement and co-opetition[24] strategies. This calls for adopting an **ecosystem-based interpretation of value-added creation through industrial processes and economic dynamics,** *going beyond national and jurisdictional boundaries* to focus directly on the *access, use and modes of appropriation of resources.*

Businesses could play a fundamental role in the elaboration of economic scenarios which would reconcile humans and their economic activities with the diversity of living systems (Barbault, 2006). Avoiding, reducing or compensating for inevitable environmental damage would not be the exclusive approach for businesses. Once interdependence is an accepted and valued principle, we move from a system of external constraints based purely on national or international public policy to a system of interactions between the evolution of biodiversity and the development of businesses. There are two diametrically opposed ways to take the complexity of ecosystems into account in the choice of production methods. The orthodox approach, set out in the first part of this section, is to homogenise the living world, to do everything possible to manage its variability and resulting unpredictability via artificial and simplified methods, such as hydroponic agriculture. By contrast, the recommended approach would seek to understand ecosystem functioning and draw upon its features to provide goods and services to consumers. This means playing with natural variability, not suppressing it, and developing adaptive strategies for both natural and economic variability, instead of pursuing optimal solutions (Weber, 1996). Businesses in all sectors could develop ecological engineering[25] for the restoration of degraded ecosystems on a hitherto unparalleled scale, through the creation of innovative markets (see Box 11 on page 265), such as payments for ecosystem services deemed essential for the viability of human communities (OECD, 2005).

(23) In Pavé's sense (2007): see p. 244.

(24) Co-opetition is the simultaneous combination of strategies of competition and co-operation between two or more businesses (Loebecke, 1999; Nalebuff and Brandenburger, 1996).

(25) See in particular the use of engineer species for ecological restoration work (Byers, *et al.,* 2006).

3.2.3

Figure 11 : Towards a new conception of the roadway system, designed to preserve ecological continuity: tunnels and viaducts replace "excavation and fill" techniques.

Businesses are thus encouraged to invest individually and collectively in practices, technologies and modes of organisation and appropriation relative to biodiversity which will guarantee its viability. All forms of appropriation and expansion of biotechnologies in direct conflict with this goal should be avoided; for example the so-called first-generation agro-fuels, which call for the expansion of monocultures known to consume large amounts of fertiliser and pesticides and threaten property rights (land ownership, access and use rights to / of resources) in rural communities in South America and south-east Asia. Instead, agriculture based on multi-species organic farming and fisheries based on the principle of "ecological gardening of the seas and oceans" is to be preferred to intensive monoculture and single-species aquaculture (see Box 10 on page 263). **"Teaming up with life"** means **building on its diversity and its benefits,** as in the recent experiments reported by Zhu, *et al.* (2000) in China: mixtures of rice varieties resistant to the most threatening pathogens formed a barrier to the spread of destructive fungus, and the resulting harvest was 89% more successful than the rice monoculture. While it is true that harvesting by hand, which is traditional in the region, was naturally suited for the separating of the rice varieties and transporting them to the appropriate markets, the chief merit of the project's promoters was to have convinced thousands of Chinese peasants to adopt this winning strategy (on more than 40,000 hectares in 2000). How are we to change the minds of the food industry, from the initial stages (seed growers, manufacturers of fertilisers and agricultural equipment) onward (to packaging, refining, processing, wholesale distribution), not forgetting crop and livestock farmers? This question is especially pressing for countries hoping to guarantee food and energy "security" when their supplies come from geopolitically[26] or ecologically[27] sensitive areas *(Courrier International,* no. 926, 2008). What limitations and opportunities exist for other industries? To give another example, why not implement compensation mechanisms for ecological damage, such that cost comparisons[28]

(26) Such as the new agricultural project covering 28,000 ha in Sudan, financed by Abu Dhabi.

(27) An Indonesian conglomerate proposes clearing a million hectares of virgin forest near Merauke in Irian Jaya for the cultivation of rice, soybeans, sugar-cane and maize.

(28) The cost of ecosystem degradation including compensatory measures (fill) versus the cost of a construction guaranteeing the viability of biodiversity (viaducts).

would promote investment in engineering and facilities in which biodiversity was central to the construction specifications[29]? All of this indicates that the potential dynamics of co-viability between businesses and the diversity of living systems are to be found in the **globalisation of biodiversity within production choices and models.**

Implementing this co-viability approach would require many businesses to revise their strategies and practices, particularly with respect to research and development. This in turn would lead to combining different sources of knowledge via interdisciplinary research and participatory science; that is, thinking collectively over the long term and **not confusing sales and profits** with regard to the global ecosystemic costs of goods and services. How are we to *make the Earth's ecosystemic "capital" increase?* **This is the same as asking how we can make profit an instrument for the diversification of the living world while making biodiversity a source of increased profits**[30].

This work does not propose to offer answers to all the questions raised, but it does aspire to make businesses more aware of the need to (a) ask these questions systematically and (b) get beyond the logical shortcuts and declarations which merely perpetuate an unviable economic system. We should not underestimate the importance of the way we talk about products and practices. Advertising has a fundamental influence on both individual and group behaviour. For example, little is to be gained by converting conventional farming to organic farming when all that this means is the substitution of one kind of fertiliser for another. Although "organically grown" is, rightly for environmental reasons[31], often emphasised on product labels to appeal to eco-conscious consumers, a recent report from INRA remind us of the limits of its usefulness for biodiversity (Le Roux, *et al.*, 2008).

The **stages of transition** to the dynamics of co-viability of biodiversity and business over the long term will need to be managed in the best possible way, both individually and collectively, by all economic agents. The time frame is a key consideration for the necessary changes to be financially profitable. A technical or organisational innovation may be profitable for a business (or a community) in the long term, but there is often no guarantee that it will be so in the short term (Trommetter, 2008). Economic time, the time needed to modify behaviours and the time needed for the hoped-for feedback to occur within an ecosystem do not take place on the same scale, hence the need for **public support policies.** For example, agriculture is one of the economic activities the most sensitive to ecological issues. Climate change is liable to alter the agricultural map around the world, creating uncertainties for farmers, especially those in developing countries who have no sort of insurance (Weber, 2002b). Farmers in the Ethiopian Highlands or the state of Oaxaca in Mexico have little chance of compensation for natural disasters, prolonged drought or collapse in prices. *Lack of insurance* is a factor rarely taken into account when *resistance to innovation* is discussed, but *it can be fatal:* **without insurance, there is no right to make mistakes.** An ecosystem approach in agriculture brings to light the hope of a new type of green revolution: nature is no longer to be exploited and dominated but treated as an

(29) See Figure 9 and the article by Dia El Din El-Quosy, p. 308.
(30) See the articles by Lesley Richardson and Nik Sekhran, p. 304, and Inge Kotze, p. 340.
(31) Improved management of agricultural runoff.

3.2.3

ally (Griffon and Weber, 1996). In this way, the poorest may be the biggest winners: experiments now under way show that we can produce more and better with far fewer inputs and without tilling the soil to any great depth.

A growing number of studies are proposing bio-economic models[32], especially for fisheries (Béné, *et al.*, 2001; Doyen, *et al.*, 2008; Martinet, *et al.*, 2007), agro-systems (Tichit, *et al.*, 2007) and bodies of water (Martin, 2004). They reveal a profound shift towards a dynamic and viable approach to ecosystem management. Other studies and models focus on support for economic agents in their interactions, negotiations and choices relative to ecosystems and their component parts[33]: for example, Gurung, *et al.* (2006) report on conflict resolution with respect to water in the Lingmuteychu watershed in Bhutan. The challenge is to adapt these methods for the interactions between ecosystems and businesses and to support businesses in the necessary transition towards dynamics of co-viability with biodiversity. **Accounting and fiscal instruments** will need to be developed, suited to the viability constraints of businesses, to complement the existing range of tools - and those now being fine-tuned[34] - for promoting the viability of the diversity of living systems.

(32) In terms of viability or co-viability, relative to various ecological problems.
(33) Such as multi-agent systems for the integrated management of natural and renewable resources developed by the GREEN team in CIRAD, http://cormas.cirad.fr/indexeng.htm
(34) For example, the European Natura 2000 network (Pinton, *et al.,* 2006).

3.2.4 Selecting indicators to manage interactions between businesses and biodiversity

The foundations of the co-viability of biodiversity and businesses have been laid. Its success will depend on how it plays out in individual businesses and also within networks of companies, incorporated into decision-making tools so as to promote the needed technological and organisational innovations. How are we to guide in this new direction the socio-economic systems which now promote biological homogenisation? How are we to understand precisely, both in *quantitative* and *qualitative* terms, the interaction dynamics between businesses and biodiversity?

These questions prompt us to look more closely at the opportunities and limitations presented by the use of indicators. Indicators help us to understand the world around us by stabilising knowledge in unpredictable environments. Levrel (2006) observes that these instruments offer a roundabout way of "approximating" a phenomenon that would be too expensive to measure directly. What distinguishes them from other instruments is that they separate the signifier (the measurement) from the signified (the object being measured) while linking them via a variety of equivalent terms (Desrosières, 2003).

Indicators of biodiversity are many and varied. Both single-parameter and composite indicators exist (Levrel, 2007); according to Christie, *et al.* (2006), this reflects the "diversity of biodiversity". An ecological approach to the diversity of living systems draws especially on indicators of engineer[35] species, umbrella[36] species, keystone[37] species and indicator[38] species, as well as indicators of ecosystem functions and processes. By contrast, a cultural approach to biodiversity will focus on species which are rare, endangered or useful to humans (charismatic species for hunting, fishing and eco-tourism). Indicators of the interactions between human society and nature are very varied. Levrel (2007) groups them into several "families": indicators of pressure-state-response, ecological footprints (Rees, 1992; Jolia-Ferrier and Villy, 2006), indicators of eco-efficiency, national accounting indicators (satellite accounts and adjustments to national accounting aggregates; see Vanoli, 2002), ecosystem services (Millennium Ecosystem Assessment, 2005a) and performance indicators commonly used by many organisations and businesses[39].

Each indicator has its advantages and limitations. Sources of conflict can arise in the course of the construction, selection and use of indicators (see Table 6). Levrel (2007) explains that the tensions between the criteria for the quality[40] of indicators can be summarised as follows:

a. **The level at which they are realistic:** their universal dimension (for comparison purposes) as opposed to their contextual dimension;
b. **A dual political-scientific dimension:** the need to be comprehensible to a wide audience (deriving simple information from a simple indicator) versus the need for an instrument of verification which will guarantee a prudent interpretation of the information conveyed;

(35) Engineer species build the environment in which they live, for example earthworms in the soil, beavers along rivers (Byers, *et al.,* 2006).
(36) Umbrella species normally require a large habitat. They are of interest to conservation programs because their evolution is a clue to the health of the ecosystem and of the totality of the species which make it up (Roberge and Per, 1994).
(37) Keystone species are those whose presence or absence affects the entire ecosystem to which they belong, as in the case of large predators vis-à-vis populations of ungulates (Paine, 1995).
(38) Indicator species are those whose presence indicates or entails the presence of some other very specific factor or element in its habitat. For example, the presence of the great bittern indicates that its preferred habitat, the reed-bed, is in a healthy condition (Levrel, 2007).
(39) For example, the indicators used in the CSR reports appended to a company's annual financial report.
(40) Criteria for quality according to the Comité du programme statistique (Desrosières, 2003) are: (a) a match between the instrument and the needs of its user (relevance) and between estimated value and actual value (precision), (b) current and timely information for decision-making; (c) comparability of the data; (d) accessibility of the data and clarity of presentation; (e) standardisation of the data and their interpretation (consistency).

3.2.4

c. Their **conventional** or **subjective character** versus their **real, objective character.**

We are now in a problematisation phase for biodiversity[41], in which constructive criticism predominates and the indicators cited above are all competing, reflecting conflicting views and analyses of the issues in question: indicators of "strong" sustainability such as the "ecological footprint" are frequently opposed to "weak" sustainability indicators such as the genuine savings rate (Levrel, 2007). The indicators of biodiversity and of the interactions between human society and nature need greater conceptual clarity and statistical robustness before they can be institutionalised with a clear conscience. It is in this context that the *adaptive co-management of biodiversity fits*, based on *technological democracy* and aiming at the *co-construction of indicators of biodiversity* and *of the interactions between human society and nature.* We need to move on from (a) *"a system of expertise to a system of co-operation between various sources of knowledge"*[42] and (b) *"the aggregation of individuals to the composition of a collective"* (Levrel, 2007)[43].

TABLE 6: SYNTHESIS OF THE CRITERIA FOR QUALITY OF INDICATORS OF SUSTAINABLE DEVELOPMENT (ISD; LEVREL, 2007, P.79)

Principle	Cognitive problems
Contextualisation	The absence of contextualisation of the ISD creates problems of interpretation
Hierarchisation	Overkill effect due to the large number of ISDs: saturation, confusion, repulsion
Feedback	ISDs seen as tools for planning rather than practical learning
Exploration	Limited ability to grasp long-term time-scales
Interaction	Limited ability to grasp non-linear interactions

Since its creation in early 2006, the *Orée*-IFB Working Group, a kind of hybrid forum in the sense defined by Callon, *et al.* (2001)[44], has sought **to co-construct** a **common language.** Thanks to all the participants - businesses, local governments, non-profit organisations - it has managed to co-construct a community of interest around the problems of the worldwide homogenisation of biodiversity, the result of our social choices and the industrial systems which have developed out of them. The interdependence

(41) Boulanger (2006) has put forward a theory of indicators adopting the three phases proposed by Dewey (1927) for the formation of a public arena in political life: (1) identification of the problem or problematisation, (2) institutionalisation, (3) dissolution.
(42) Combining lay knowledge and expert knowledge, tacit knowledge and explicit knowledge (Cowan and Foray, 1998).
(43) See the articles by David Osborn, p. 318, and Jean-Claude Dauvin, Stéphanie Moussard and Jean-Paul Ducrotoy, p. 334.

Issues for the creation of ISDs	Goals of the ISDs	Example of an ISD
To position ISDs with respect to specific shared worlds	To provide one or more common languages which will facilitate debate	Eco-efficiency (refers to the "industrial world")
To take into account the users' own priorities	To offer effective signals organised by order of importance	Human development indicator ("headline" indicator generating activism)
To identify signals which will get people to change their preferences	To be a source of surprises which will create cognitive dissonance and practical learning processes	Ecological Footprint (educational tool based on changes in scale)
To find data that will connect short-term and long-term dynamics	To connect micro-level short-term activity with long-term global change	Critical natural capital (takes account of resilience and threshold effects and enables the construction of simulations)
To find data about society-nature interactions	To help grasp the complexity of society-nature dynamics	Multi-agent system or models of system dynamics (takes numerous interactions into account)

of socio-economic and ecological systems has been progressively recognised by the participants, as is illustrated by the self-assessments focusing on the *Business and Biodiversity Interdependence Indicator* (section 2). In due course, we will encourage the co-construction, institutionalisation, appropriation and implementation of *batteries of consensually formulated indicators*, which will be essential to incorporating mechanisms for the co-viability of biodiversity and business into the strategies and practices of all businesses. First, however, we need *an interface which makes sense to all concerned.* We thus propose the ***"Biodiversity Accountability Framework"***, an interdisciplinary instrument and the biodiversity equivalent to the "Bilan Carbone" (methodology for greenhouse gas accounting), designed to highlight the *responsibility of organisations to ecosystems.*

(44) The Working Group was open in structure: the group was brought together to discuss a range of topics dealing with the problems of biodiversity. Its membership was varied, and it was directed jointly by a scientist and a representative from the business world.

3.3
BUILDING THE BIODIVERSITY ACCOUNTABILITY FRAMEWORK

3.3.

As long as we accept the paradigm in which a company's success is measured in terms of profit (…) thinking in terms of sustainable development costs money… At present, profit and loss statements and balance sheets make no reference to the cost of consuming externalities, resources which are now freely available, like water, air and energy… If we did incorporate this type of information, the resulting financial reports would look nothing like those we have today… Taking environmental and social indicators into account in calculating corporate profits could make a big difference.

Emmanuel Faber, Deputy CEO, Danone (2008)[45]

As Jean-Louis Weber of the European Environment Agency[46] has pointed out, ecosystem accounting could be developed at all the relevant levels - the Earth as a whole, nations, activities such as development projects and economic entities such as businesses, local governments and even citizens. The *Orée*-IFB Working Group's analysis of the direct dependence of industries on biodiversity[47] has confirmed the need to establish a new accounting system for businesses, complementing standard financial reporting. The methodology of the "Bilan Carbone" proposed by ADEME measures the amount of greenhouse gases emitted by the totality of the physical processes required to sustain specific human activities or organisations, insofar as their boundaries are clearly definable. However, it does not and is not designed to take account of the interactions between living systems and the world of business.

Faced with the challenges posed by the increasing erosion and homogenisation of biodiversity, we propose to develop an **integrated accounting system,** applicable to all economic entities. The aim is to organise and make available high quality information to stimulate businesses, shareholders, governments, local authorities, consumers and citizens to change their choices and behaviours. This new system must at once account for the relations between the business world and that of living systems and bring to the fore a different perception of the place of human activities within biodiversity. The *Biodiversity Accountability Framework*[48] will aim to introduce consistency into the proliferation of initiatives, often

(45) Quoted by F. Roussel in an article of 29 March 2008 on Actu Environnement :
http://www.actu-environnement.com/ae/news/nouveau_schema_economique_4783.php4
(46) See p. 344.
(47) See section 1, p. 46.
(48) "Bilan Biodiversité".

3.3.

contradictory and split up by industry sector, in order to take socio-ecological issues into account. It is an interdisciplinary method whose outlines and boundaries reflect the **responsibility of organisations to ecosystems.** Although it can be adapted to all organisations - businesses, administrations, local authorities and non-profit organisations - our focus here is on businesses. The *Biodiversity Accountability Framework* falls into two inseparable parts:

Part A - Ecosystem accounting for business;
Part B - Ecosystem accounting for the relationships between businesses.

TABLE 7: THE STAGES OF THE BIODIVERSITY ACCOUNTABILITY FRAMEWORK

Part A: Ecosystem accounting for business

1 – Identifying and evaluating the monetary transactions related to biodiversity

2 - Improving and consolidating the accounting methods for the non-monetary inputs - outputs in connection with the business's operations

3 - Providing high quality information about the nature of interactions between the business's operations and biodiversity

Part B - Ecosystem accounting for the relationships between businesses

1 - Extending the ecosystem accounting for business to all economic agents
From the owners, managers and exploiters of land and sea ecosystems to shareholders

2 - Evaluating the costs of the management and restoration of ecosystems to be imputed to the businesses
Active involvement of businesses in ecosystem accounting

3.3.1 Part A: Ecosystem accounting for business

In modern accrual accounting[49], assets can be defined as the future economic benefits controlled by a financial entity, resulting from past transactions or events (Deegan, 2005; Trotman and Gibblins, 2003). They correspond to the resources the business needs to produce goods or render services, and are normally ranked in descending order of liquidity on balance sheets. Current assets, such as cash, receivables and inventory, are distinguished from fixed or long-term assets, such as buildings, financial holdings and intangibles. An asset is recognised only if the financial entity has control over the item in question, if its value can be accurately estimated and if its future economic benefits are likely to materialise[50]. Liabilities, in turn, can be defined as sacrifices of future economic benefits which the business is obliged to make to others in the present, as a result of past transactions or events (Deegan, 2005; Trotman and Gibblins, 2003). Like assets, liabilities may be current or long-term, depending mainly on the repayment schedule of these future sacrifices (payables, loans, provisions). Along with these two types of liability, the business has equity in the form of share capital issued, reserves and earnings. These constitute its obligations to third parties which may or may not require an outflow of resources.

Environmental financial accounting has been developed on the basis of this system (de Beer and Friend, 2006). It focuses on actual or probable transactions of an "environmental" type, that is, those with a **direct financial impact** on the business. Probable transactions have to do with expenditures contingent on uncertain future events, such as the remediation of polluted sites, the management and disposal of hazardous materials, the management of time-limited facilities whose renewal requires authorisation, or liability for products which have reached their end-of-life (Crédit Agricole Chevreux, 2006). Identifying and categorising these transactions can be done in various ways in order to guide action plans and decision-making. We may speak of different types of income and internal costs (Environmental Protection Agency, 2005; 2006). However, costs "external" to the business are not included in such an accounting system. These include environmental damage for which a company is not financially responsible, often because there is a legal vacuum[51] (de Beer and Friend, 2006; Huglo, 2007a) or no clearly established property rights, as the Coase Theorem[52] (1960) states. Businesses thus concurrently develop accounting systems for their consumption of materials, substances and energy, and for their production of effluents, emissions and waste. This **non-monetary accounting** provides data for the indicators used to draw up corporate social responsibility (CSR) reports. The aim is to control and reduce the negative environmental externalities of company operations.

(49) As opposed to cash-based accounting which only records cash flows during a given year. For the sake of simplicity, only general financial accounting principles are summarised here, without going into detailed discussion of accounting requirements for each state.

(50) How to account for intangible assets is a subject of heated debate in the context of the international standardization of accounting methods (Davis, 2005; Seetharaman, *et al.*, 2004).

(51) Ecosystems and biodiversity are neither physical nor legal persons and thus cannot be said to have rights.

(52) The theorem states that when trade in an externality is possible and there are no transaction costs, bargaining will lead to an efficient outcome regardless of the initial allocation of property rights. In practice, obstacles to bargaining or poorly defined property rights can prevent Coasian bargaining.

3.3.1

On this basis of these concepts combined with the research done by the *Orée*-IFB Working Group, we propose the development of an **ecosystem accounting framework,** designed to accommodate any type of business[53]. This first part of the ***Biodiversity Accountability Framework*** aims for *a more integrated method for measuring performance, the true cost of goods and services* and part of the goodwill of businesses. It complements the balance sheet and annual income statement by:

1. Identifying and evaluating the monetary transactions related to biodiversity;
2. Improving and consolidating the accounting methods for the non-monetary inputs and outputs in connection with the business's operations;
3. Providing high quality information about the nature of interactions between the business's operations and biodiversity.

Although this first part of the *Biodiversity Accountability Framework* is sufficiently flexible to accommodate every type of industry or organisation, the quality and accuracy of the information provided will be affected by the business's internal management dynamics as well as its interactions, or those of its representatives, with the totality of the stakeholders[54]. The accessibility and external verification of its data by an independent body subject to oversight would undoubtedly guarantee their trustworthiness.

1- Identifying and evaluating the monetary transactions related to biodiversity on the basis of standard accounting principles

In addition to the balance sheet and annual income statement, this first stage involves evaluating and reporting the **monetary transactions relating to biodiversity,** including those relative to rights of access, use and ownership. The point is not to put a price on biodiversity, but rather to identify transactions connected with it based on the business's standard financial reports. This includes all the **income** and **expenditures, assets** and **liabilities, profits** and **reserves connected with living systems.** All of these "chart of accounts items" are critical to production processes and contribute to value-added creation. They include among other things:

- Raw materials and finished or semi-finished goods derived from living systems (of both the present and past eras), whether purchased, stored and / or sold, including biotechnologies[55];
- Services sold in connection with living systems, including land / ecosystem management and the processing of organic matter at its end-of-life;
- Real property and land assets controlled or owned by the business, that is, its direct spatial footprint;
- Transactions in connection with compensation for ecological damage (mitigation banking) and with emerging markets for ecosystem services.

2- Improving and consolidating the accounting methods for the business's non-monetary inputs - outputs

The second stage of a business' ecosystem accounting is similar to the **non-monetary accounting system** based on performance indicators now used for some environmental management systems.

(53) With minor modifications to the *Biodiversity Accountability Framework,* other economic entities such as administrations could develop their own ecosystem accounting systems.
(54) The feedback principle (Levrel, 2007).
(55) A definition of this term is offered on p. 47. Some businesses "create" biotechnologies in-house, which can give rise to intangible assets.

These indicators primarily reflect the control of:

- Resources consumed by the company to produce goods and deliver services, that is, its **inputs** (organic and inorganic materials, energy), whether purchased or otherwise;
- Emissions, effluent, by-products and waste produced by the company, that is, its **outputs,** including that of the end-of-life of the goods and services sold.

This type of environmental accounting, familiar in the business world, takes several forms: greenhouse gas accounting (Roxburgh and Davies, 2006), "Bilan Carbone" (ADEME, 2007), accounting methods for agricultural inputs (Breembroek, *et al.,* 1996; Lamberton, 2000) and industrial ecology methods for managing the flow of materials and energy (Erkman 1997; 2006; Schalchli, *et al.,* 2008). Businesses aggregate this type of information for their non-financial reporting, which is often appended to the balance sheet and income statement in the form of a CSR report.

At present, sector- and subject-based approaches are dominant, with a focus on energy-related topics. This new accounting system would rely on a life-cycle analysis (including the design, construction, use, distribution and end-of-life of the objects analysed) and is to be expanded to encompass all input-output flows connected with a business's operations, including those of the goods and services it sells and those of its assets (raw materials, machinery, offices, vehicle fleet). This applies to all organic and inorganic substances, not merely the chemicals covered by existing legislation[56].

3- Providing high quality information about the nature of interactions between the business's operations and biodiversity

Identifying and evaluating the monetary transactions related to biodiversity makes it possible to identify the "items" related to biodiversity which have been incorporated into the company's financial accounts. Accounting for the input-output flows connected with a business's operations enables the analysis of its flows of material and energy, both organic and inorganic. Both should not be carried out in isolation, with no reference to the contexts of the quantitative information gathered: *the point is to make these data meaningful.* The third stage of this first part of the *Biodiversity Accountability Framework* is intended to provide *high quality information about the nature of interactions* between the business's operations and biodiversity. Applying the *Business and Biodiversity Interdependence Indicator* to each of its products and operations can help the business to achieve this goal; participating in ecosystem accounting would also be useful[57]. This means in effect asking the following questions:

- In terms of the economic transactions related to biodiversity, what are the organisational levels of living systems involved? How are these biodiversity components managed, from their origin to their end-of-life? How does the business take account of the variability, health and complexity of the ecosystems in question?
- How does the business manage its consumption of matter and energy? How does the business take account of the variability, health and complexity of the ecosystems involved in their production? How are the impacts on ecosystems of the business, its products and services, determined and managed?

(56) See for example the European regulation REACH at http://ec.europa.eu/enterprise/reach/index_fr.htm
(57) See under Part B of the *Biodiversity Accountability Framework,* p. 285.

3.3.1

- Do the choices and models of production, development and innovation, as well as the modes of appropriation, lead to the degradation of ecosystems and the homogenisation of biodiversity?

Depending on the nature of its interactions with living systems, the business can then go on to define areas of possible action, in conjunction with all its stakeholders, through which its operations can co-evolve with the diversity of living systems. The goal, as we have said, is the elimination of free access to resources, towards the adaptive co-management of biodiversity via modes of co-ordination of economic agents that are both socially equitable and tailored to both local and global concerns. Guaranteeing or restoring the viability of biodiversity within ecosystems, to which human beings and industrial systems belong, will require many changes in perceptions and in practices. Technological and organisational innovations are essential, both individually and collectively[58]. Costs will vary depending on the situation, particularly with respect to the specificity of the assets concerned[59] and the business's capacity to influence the practices of its suppliers and customers. Who will shoulder the costs of change? Or rather, how are we to share these costs equitably? A small or medium enterprise cannot dictate the practices of its suppliers. It will probably have to choose between the existing options available on the market, depending on its financial resources[60]. In the case of monopolies, oligopolies and vertically integrated industries, where a single company controls all or much of the supply chain[61], the businesses involved will have more freedom of action. Irrespective of the situation however, it is crucial to expand the discussion to cover the interactions between companies, shareholders and land use managers.

(58) Involving several businesses and / or other economic agents.
(59) The more specific an asset is, the more expensive, or even impossible, it will be to re-deploy it, for example in the case of a hydroelectric dam, a port or a waste management facility.
(60) However, the large number of small and medium enterprises means that the organisations which represent them (unions, professional organisations) carry some weight. These organisations are to be encouraged to play an important role, as in the case of this contribution by *Orée*.
(61) From the extraction or production of raw materials to the sale of finished goods.

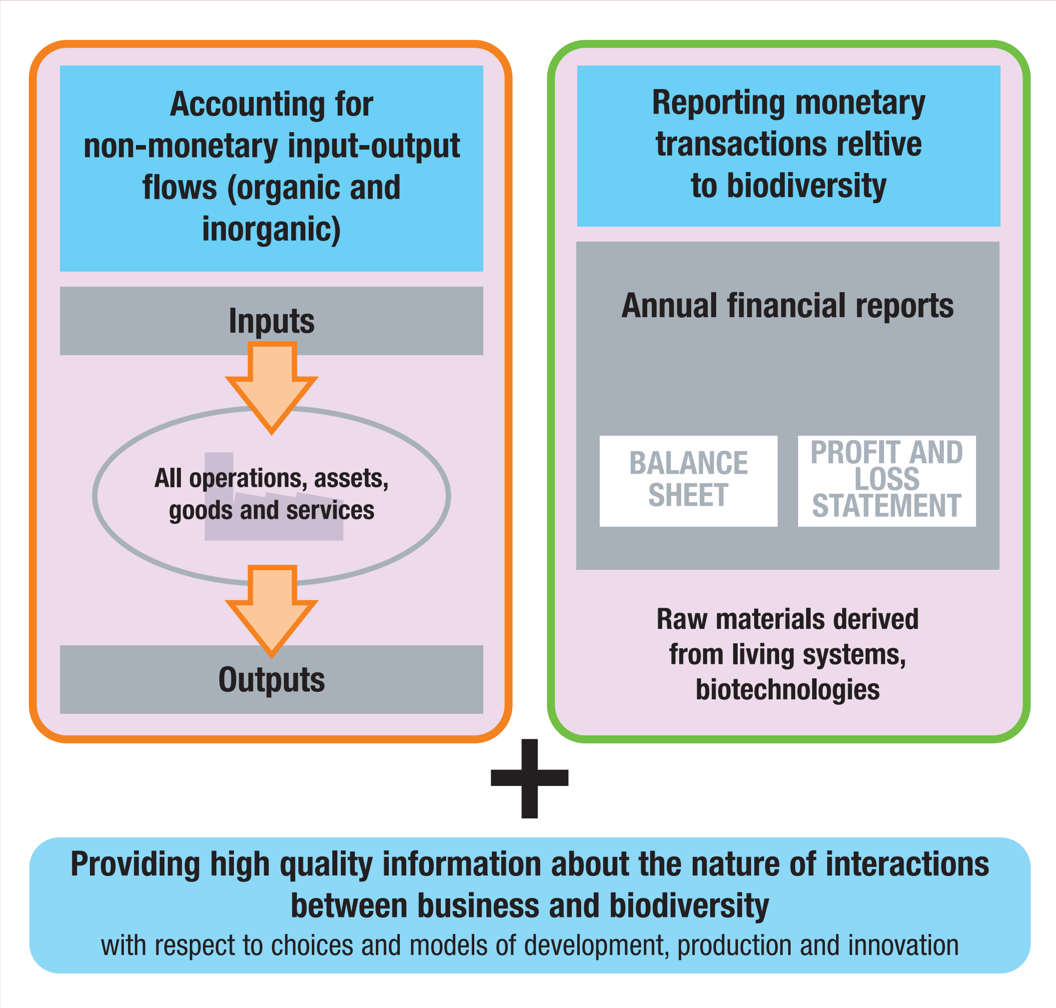


Figure 12 : Part A of the Biodiversity Accountability Framework: from financial and CSR reporting to ecosystem accounting for business.

3.3.2 Part B: Ecosystem accounting for the relationships between businesses

Modern capitalism is organised like a gigantic limited company. At its base, three hundred million shareholders control almost all the world's market capitalisation. (...) They hand over half of their financial assets to some tens of thousands of portfolio managers whose sole aim is to enrich their principals.
Jean Peyrelevade, 2005.

A business's environmental responsibility is determined by the legislation in force in its country of operation. Although classically only persons, their property and their well-being may be compensated for damages in most cases of harm (Huglo, 2007a), encouraging changes are happening in some countries, as Patricia Savin shows in her analysis of the insertion of the European Directive on Environmental Responsibility[(62)] into French law. However, regulatory frameworks do not yet take into account all the direct and indirect impacts of businesses on biodiversity, particularly when these are caused by a subsidiary in a foreign country with more permissive legislation. Indeed, a parent company can often evade not only its responsibility for the environmental damage done by its subsidiaries, but also the costs of that damage, by legally liquidating entities whose environmental liabilities are particularly onerous. As Huglo (2007b) notes, *"this solution relies on the principle of the limited company's legal personhood and the separation of the assets of the company and of its shareholders, as established by the famous Salomon vs. Salomon decision of 1897".* This is part of the story of the transition from intermediated finance[(63)] to global capitalism (globalised shareholders), or "total capitalism" as Jean Peyrelevade (2005)[(64)] calls it.

Given these facts, we may ask: how can we make those who take risks today also accept their direct and indirect consequences for ecosystems and biodiversity, both geographically and temporally? The second part of the *Biodiversity Accountability Framework* addresses the **relationships among businesses.** How can **all economic agents,** from shareholders, businesses, governments, to consumers and citizens be brought to face up to their **joint responsibilities** on a scale which is necessarily long-term, without "environmental dumping" from polluting countries to more permissive ones (Thébaud-Mony, 1991)? To answer these questions, we propose to:

1. **Extend ecosystem accounting for business to all organisations,** from the owners, managers and exploiters of land and sea ecosystems to the world of global finance
2. **Evaluate the costs of the management and restoration of ecosystems to be imputed to businesses,** through their active involvement in marine and terrestrial ecosystem accounting.

(62) See p. 324.
(63) Intermediated finance refers to the situation in which the supply of capital to businesses is entrusted to a limited number of specialised institutions (primarily banks), all tightly regulated by national government authorities.
(64) See Susan Steinhagen's article on biodiversity and the world of finance, p. 297.

1- Extend ecosystem accounting to all organisations

This first stage aims to develop an **ecosystem-based conception of value-added creation, along the entire supply chain.** This means addressing economic dynamics and commercial exchange which *transcend legal or national boundaries:* the approach described for the first part of the *Biodiversity Accountability Framework* is to be expanded to global networks of companies, from business owners to raw material extraction, processing and production plants. From the owners, managers and exploiters of land and sea ecosystems to shareholders world-wide, *at each stage of value-added creation* it is essential to:

1. Evaluate and report the monetary transactions related to biodiversity;
2. Account for and report the organic and inorganic inputs – outputs connected with the organisation's activities, including its assets and the goods / services sold;
3. Provide high quality information about the nature of interactions between the business's operations and biodiversity.

It amounts to apply a life-cycle analysis, covering the entire supply chain for *every product, service, activity / operation and legal entity,* and taking into account all direct and indirect interactions between economic and ecosystem dynamics. In this way shareholders and consumers could monitor **the ecosystemic performance of any business** (both parent company and subsidiaries), **any region** and **any country,** so that new forms of co-operation - competition between organisations emerge. These new forms of co-opetition could include data-gathering (including data traceability) as well as the elaboration of new standards for aggregating, managing and communicating these data in the form of standards, labelling, technology, methods and codes of practice, according to the aims and needs of users.

To reduce transaction costs, complementary approaches would include:

- *Vertical co-operation* throughout the supply chain, from the harvesting, extracting or production of raw materials down to the sale and end-of-life of products, in order especially to ensure the traceability of information;
- *Horizontal co-operation* between businesses competing in the same market, to establish common standards for their industry sector.

We should not underestimate the direct (establishing new standards) and indirect (power relationships with respect to the appropriation and implementation of standards, emergence of barriers to competition) costs associated with standardisation. The automotive industry is a good example of this (Fabbe-Costes, *et al.,* 2005). The direct costs need to be spread out in a socially equitable way, so as to pre-empt attempts at blocking or circumventing the problems and to avoid losing sight of the long-term goals, that is, the viability of ecosystems and of their biodiversity. This is the focus of the next stage of Part B of the *Biodiversity Accountability Framework.*

2- Evaluate the costs of the management and restoration of ecosystems to be imputed to businesses

Implementing a business's ecosystem accounting, following the methodology of Part A of the *Biodiversity Accountability Framework* and the first stage of Part B described above, makes it possible to come up with a close approximation of the total cost of its goods and services. This leads to an ecosystemic approach to value-added creation along the supply chain (figure 13). Conveying all this information to citizens and other economic agents, through a *reliable* and *transparent annual reporting system* and the *proper labelling of goods and services,* would be an especially constructive way

3.3.2

to speed up the reintegration of the economy into biodiversity.

Yet, the **additional unpaid costs** of the **maintenance and restoration of ecosystems**[65] exploited by economic activities still need to be evaluated. Businesses are directly and indirectly involved in the management of ecosystems, especially with respect to the *land that they, their subsidiaries and suppliers own*, as well as the areas which provide the *raw materials* and *energy they consume*. To calculate the costs of management and restoration imputable to them, **businesses** - from the shareholders, by way of the supply chain, to the owners, managers and exploiters of land and sea ecosystems - **could jointly participate in the co-construction of marine and terrestrial ecosystem accounting,** which is actively being developed at this very moment.

Ecosystem accounting is based on collective decision-making and long-term policies for the integrity and health of ecosystems world-wide, drawing in particular on the goals of the Convention on Biological Diversity. In Europe, for example, ecosystem accounting is gradually coming into use thanks to significant improvements in the monitoring, collection and processing of data, chiefly through statistical methods which facilitate integrated data assimilation (Weber, 2007)[66]. Based on a mapping of land use[67], this technique has been applied to all the administrative regions of the 24 member countries of the European Environment Agency.

Ecosystem accounting ought to provide high quality information about the interactions between biodiversity and business[68]. It should eventually make it possible to identify the viability constraints of biodiversity at all relevant socio-economic and ecological levels[69]; hence the importance of co-constructing (in tandem with all the stakeholders) indicators for monitoring and analysing ecosystem dynamics, which would then generate data for Part A of the *Biodiversity Accountability Framework* (ecosystem accounting for business). With the ultimate goal of implementing *efficient* and *socially equitable management of ecosystems*, we would draw upon complementary health, integrity and resilience indicators for each organisational level of living systems (Levrel, 2007) - species, populations, communities, micro- and macro-habitats, landscapes, ecosystems, not forgetting the border areas separating different habitats (ecotones) and including the areas we live in, exploit or depend on, whether rural, urban or industrial.

(65) See Jean-Louis Weber's article, p. 344.
(66) Case studies have been initiated around the Mediterranean Sea, in the Camargue in France, at Doñana in Spain, Amvrakikos in Greece and in the Danube delta in Romania.
(67) On a scale of 1/100,000, via the "Corine land cover" database; though, this is still too large-scale to show all the diversity of living systems, for instance the ecotones of wooded countryside.
(68) See Part A of the *Biodiversity Accountability Framework,* p. 281.
(69) See the article by David Hughell and Rebecca Butterfield on the assessment of the efficacy of FSC forest certification in Guatemala, which highlights the usefulness of satellite imaging in this context (p. 328).

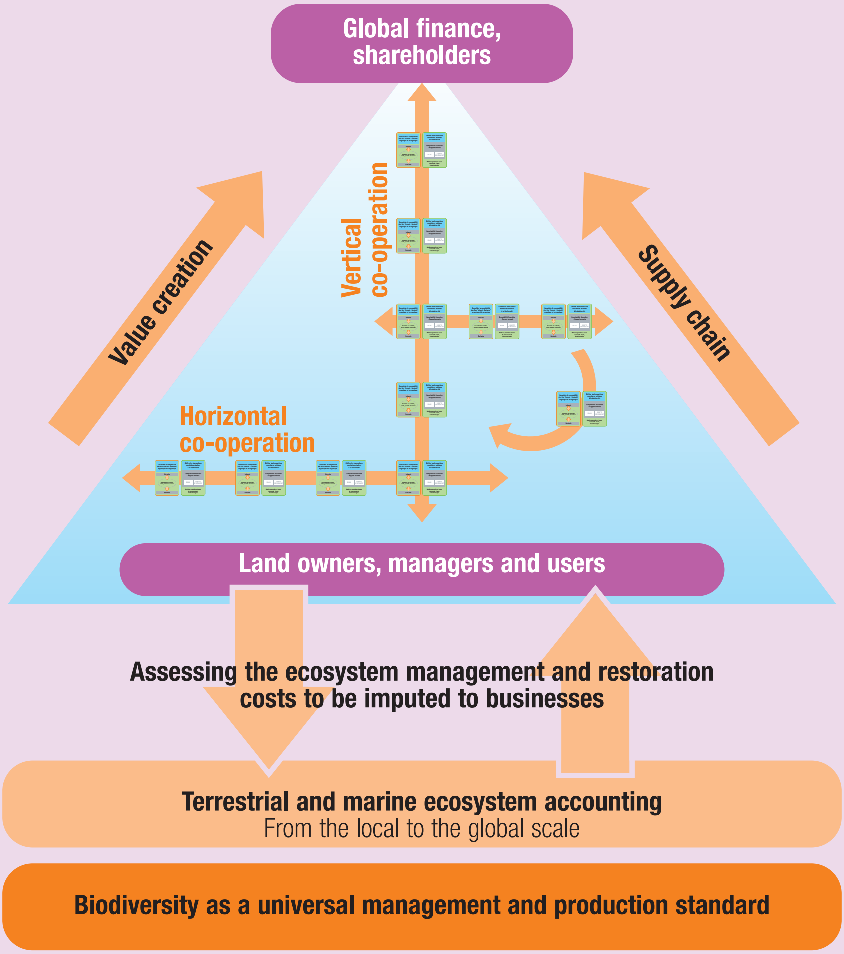


Figure 13 : Part B of the Biodiversity Accountability Framework.
Ecosystem accounting is expanded to the relations between businesses.

At this stage of the *Biodiversity Accountability Framework*, the outlines of the responsibility of businesses to ecosystems can be clearly drawn. Ecosystem accounting for businesses (Part A) and for the relations between businesses (Part B) allows us to grasp the relationships between the worlds of business and of living systems, and to move towards economic arbitration based on an ecosystem approach to value-added creation. How are we to implement this new form of accounting, complementing the actual system, while ensuring the viability of the businesses involved? What individual and collective incentives will stimulate changes in perceptions and practices? How can we ensure that all economic agents are looking forward together, not sideways at their neighbour's business? These questions relate to the institutional innovations necessary for the onset of dynamics of co-viability of biodiversity and businesses. The final part of section 3 provides some practical answers.

3.3.3 Towards a taxation system based on consumptions of nature

What good are science and technology if they are under-utilised? To truly benefit from them, the right behaviour, incentives, rules and institutions have to be in place. Designing, stimulating and implementing these, as past experience shows, is a far more difficult enterprise than producing science and technology, complex as those fields may be nowadays. (…) First of all, the price system has to be as reliable a guide as possible, but it is not easy to specify what this means, much less to guarantee it. The market is essential but in many respects inadequate and biased, as is the price system which emerges from it. Consequently, a body of rules with the goals of efficiency and equity is vital to orientate certain critical prices and support the operations of certain markets.

Alain Grandjean, Claude Henry et Jacques Weber, 2007

To recognise that biodiversity is our first insurance policy in an uncertain world, where changes and surprises in ecosystems are the norm, is in effect to ask how we can insure against uncertainty and preserve our future. The research of the *Orée*-IFB Working Group has confirmed that many companies are realising that their operations, and their effects on the ways of life of their customers, suppliers and employees, are intrinsically bound up with biodiversity within one living system, the biosphere. The proposed *Biodiversity Accountability Framework* provides tools for concrete action. It is an accounting system which establishes links between (a) businesses and biodiversity and (b) groups of businesses relative to biodiversity. Its purpose is to provide economic agents with the data needed **to adapt in the short term and survive in the medium to long term** in a world of accelerating global ecosystem change. The challenge lies in convincing all the stakeholders of its relevance, that is, to overcome the resistance due to the economic and social costs of introducing this new form of accounting. What guarantees or insurance against the possibility of failure would a business have if it makes a commitment to ecosystem accounting within the meaning of the *Biodiversity Accountability Framework?* This is a legitimate question, for the very viability of some businesses could be compromised in the short term.

The arguments in favour of the *status quo* are many, and have much to do with organisational inertia: high transaction costs, internal resistance to change and the risk of bankruptcy. However, *"the rational risk-taking individual, the Schumpeterian entrepreneur, is as laden with guarantees as the Senegalese fisherman is with talismans"* (Weber, 1992). For the fisherman, debt, financial or moral, lies at the heart of social ties and takes the place of insurance, whereas a business is totally dependent on the world of global finance, which controls, finances and insures it against risk. The world of business, including that of global finance, is also particularly sensitive to the rules – both *incentives* and *disincentives* – which govern markets: business lobbies influence these on every possible occasion to ensure the sustainability of the operations of their clients or principals. The issues of *risk* and *guarantee against failure*, in the individual and collective innovation needed for the co-viability of biodiversity and businesses, thus appear in a new light.

The Millennium Ecosystem Assessment (2005a), a research project carried out by 1360 experts from around the world, demonstrated that biodiversity and ecosystem services underpin economic activities and ways of life of human populations. *These services*[70] *are free in the sense that they have no intrinsic price; they do not cost anything in and by themselves.* Only the costs associated with rights of access, use and ownership, as well as labour, transport or other acquired assets (machinery) are subject to monetary transactions[71]. Why then is it rational to take biodiversity and ecosystems into account? An answer to this question should *avoid confusing* the *"illusion of no cost"* with *"hidden costs"*, here equivalent to the cost of inaction. If nothing is done to ensure the viability of biodiversity, the **hidden costs associated with its growing homogenisation** (and the concomitant degradation of ecosystems) **will hurt the economy as a whole,** not only some activities or businesses. To change the mind of a decision-maker convinced that some action or change in practice will be expensive, often all that is needed is to show *what it would cost not to act or not to decide.* At present, the team led by Pavan Sukhdev[72] is taking up the approach[73] adopted by Nicholas Stern's team in his 2006 report on the economics of climate change. This involves comparing the economic benefits of biodiversity with the costs of its erosion, the costs of inaction and, finally, the costs of its conservation. As noted in the first section of this work, trying to estimate the economic and societal costs of the deforestation of the Amazon rainforest is equivalent to asking how much it would cost to restore this "lung" of Planet Earth in all its complexity. However, the failure of Biosphere 2, an experiment which cost approximately 200 million US dollars and covered an area of only 1.27 hectares, underscores our inability to create a viable artificial ecosystem in which we could live sustainably: *the homogenisation of biodiversity amounts to social and economic suicide.*

According to Dahle Oystein, former vice-president of Exxon's Norwegian subsidiary, *"Socialism collapsed because it did not allow the market to tell the economic truth. Capitalism may collapse because it does not allow the market to tell the ecological truth."* As long as biodiversity has no economic "value" and **there is no cost,** at least apparently and in the short term, associated with its destruction and homogenisation, businesses will have a hard time finding rationality in the urgency to integrate their business strategies and operations into the diversity of living systems (Weber, personal communication, 2008). We will not resolve this as long as our overall conception of the tax system excludes biological diversity. Many industries have substantial negative externalities with respect to ecosystems and have been on a "fiscal IV drip" for decades[74]. *We cannot but question the relevance*

(70) For examples, see pp. 58 and 59.
(71) We cannot own genes, the hydrological cycle of a river system or the CO_2 in the atmosphere, but only acquire rights (or monopoly) of access and / or use.
(72) http://ec.europa.eu/environment/nature/biodiversity/economics/index_en.htm
(73) Evaluating separately the costs of climate change and those associated with the inaction of economic agents.
(74) Agriculture in the USA, Europe and Brazil, to mention only the most well-known cases.

3.3.3

of present-day incentives (Houdet, 2004). How is biodiversity to be integrated into business operations if public policies and regulations encourage its homogenisation? For example, how are we to protect the biodiversity of agricultural land when it is financially more attractive and administratively less burdensome to apply for assistance to grow monocultures of maize or soybeans[75]? The concept of "perverse subsidies" is commonly invoked (Green Scissors, 2003 and 2004; Van Beers and Van den Bergh, 2001). This is why we must focus on *institutional innovations* which shape *technological and organisational choices* and the *dissemination of ensuing innovations*, because they can determine their nature and objectives. **Institutions,** *incentives* and *disincentives* are needed to make **implementation of the *Biodiversity Accountability Framework* profitable,** along supply chains at each step of value-added creation, from the extraction, harvesting or production of raw materials up to the sale and end-of-life of goods and services. The same goes for any other measures to promote the co-viability of the world of business and that of living systems.

Sooner or later we will have to halt the trend towards encouraging more environmentally responsible behaviour via new taxes added on top of existing ones. *A radical change in modes of regulation is called for:* we need to move from a taxation system based on human and manufacturing capital to a different system based on the **consumptions of natural capital** (Grandjean, *et al.*, 2007; figure 14). Although such a tax system is essential to promote individual and collective investments in the co-viability of biodiversity and business – as well as the widest possible dissemination of the resulting innovations, it remains a "useful fiction" at the moment. Further analysis requires close co-operation between all countries, and in its absence we can merely sketch its possible outlines.

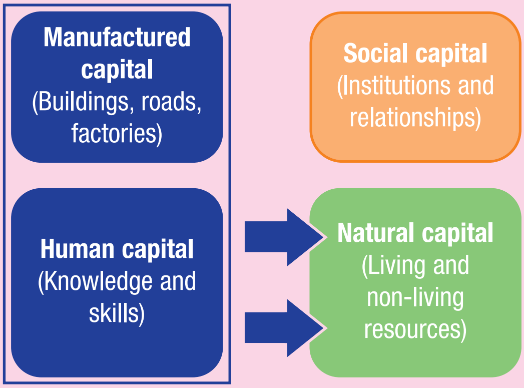


Figure 14 : Given the four types of capital, the goal is to move from a taxation system based on human and manufacturing capital to an entirely different system based on the consumptions of nature (adapted from the Millennium Ecosystem Assessment, 2005a).

In addition to the abolition of perverse subsidies, extra charges could be levied on goods, services and activities which negatively impact on the viability of ecosystems and biodiversity, while the traditional tax bases for businesses and households, including labour, value-added and income taxes (for employees) as well as taxes on business profits, *would gradually be replaced* with new ones based on[76]:

- The business's input-output flows (both organic and inorganic), including materials, substances, by-products and energy;

(75) Replacing natural diversified meadows with fodder crop monocultures is subsidised by the EU's Common Agricultural Policy.
(76) With reference to ecosystem accounting for business, see Part A of the *Biodiversity Accountability Framework*, p. 279.

- The nature of the influences of the business's operations on biodiversity and ecosystems, with respect to their use, modes of appropriation, technologies and their dissemination on land and sea areas.

The taxation system could be calibrated in terms of:
- The volume of input-output flows associated with goods, services and activities, based on a single tax rate, rather like Value Added Tax (VAT) for most goods in some countries;
- Collective, transparent choices relative to problematic products, substances, materials, services or operations which call for significant changes in behaviour, via the complementary application of an adjustable tax rate using a progressive scale incorporating both incentives and disincentives[77]. For example, the degree of erosion and homogenisation of biodiversity caused directly or indirectly by a business's operations, goods or services could be assessed in terms of the costs of maintenance and restoration of the ecosystems for which it were to be found responsible. This assessment would be possible thanks to ecosystem accounting for relationships between businesses[78] and the combination of "collective goals for adaptive co-management of biodiversity – modes of regulation / co-ordination systems of economic agents".

Though the transition between these two different systems of practice, management or co-ordination will need to be managed through public support policies, the **fiscal neutrality of the changeover to a tax system based on the consumption of natural capital must be guaranteed** (European Environmental Bureau, 2002). It is out of the question to construct - or perpetuate - a multi-layered tax system. Any new tax revenue would have to replace an equivalent amount derived from one or more previous taxes (Grandjean, *et al.,* 2007). This would not jeopardise the financing of essential public expenditures, such as education, pensions or social security. This new taxation system would aim both to stimulate changes in behaviour - to reduce undesirable emissions, for example - and to produce revenue for the national treasury. Indeed, it is neither technically feasible nor economically desirable to seek to eliminate all pollution, although some can and should be (heavy metals, for example). Abolishing all subsidies leading to the destruction and / or homogenisation of biodiversity and redistributing them to businesses which promote biodiversity as a management or production standard would be a very positive and tax-neutral incentive[79]. **Tax arbitrage** by companies and their shareholders would no longer focus on *payroll* or *profits,* but **on the consumption of natural capital** (organic and inorganic raw materials, energy); bearing in mind the goals and constraints for the co-viability of biodiversity and businesses (p. 264). We would switch from an economy which wastes resources, renewable or otherwise, to another which would most likely have an increased need for labour.

Various complementary strategies could be advanced **to mitigate the adverse consequences** (fiscal distortion) of such a tax system on households (in terms of employment, social equity and wealth-sharing) and on businesses (duration of engage-

(77) This could copy the principle governing the "bonus / malus" system now applied to the purchase of new vehicles in France. It rewards the purchase of less polluting cars (based on emissions of CO_2 per km) and penalizes the heavier polluters. It is essential that the system be gradually tightened by lowering the threshold of eligibility for "bonuses" and "maluses" on a schedule which allows manufacturers to adapt their production methods accordingly.

(78) See Part B of the *Biodiversity Accountability Framework,* p. 284.

(79) On the model of the "polluter pays" principle, on which polluters are taxed to provide subsidies to those who invest in pollution reduction. This does not increase the tax burden.

ment of problematic assets), *especially the most vulnerable*. Mechanisms would need to be established to insure against failure or bankruptcy, to allow economic agents to adjust: that is, new incentives need to be created, particularly to reduce the costs associated with the loss of the specific assets or markets which had contributed to homogenising biodiversity. Following up on recommendations by the OECD (2001) for encouraging ecological taxation, efforts to reduce tax distortion could include:

- *A temporary reduction in the tax burden* through subsidies for research into innovations for the co-viability of biodiversity and businesses[80], especially in the case of operations, technologies or assets which are problematic for the viability of ecosystems and biodiversity;
- *Temporary exemptions or differential tax rates*, by industry, to enable them to adjust gradually, taking care to define the criteria for eligibility so as not to lose sight of the goal of the co-viability of biodiversity and business;
- *Effective border taxation adjustments*[81], if the new taxes would temporarily put domestic businesses in a weak position in particularly competitive international markets;
- Crucially, the implementation by all states of an *effective system of international co-ordination* to ensure compliance with the rules beyond national borders and the rapid and equitable resolution of disputes, especially with respect to the inevitable tax distortions; stressing once again the need to guarantee the viability of the most vulnerable human communities.

We could also envisage an individual "ecosystem card"[82] containing a basket or portfolio of permitted inputs and outputs, to be debited with every purchase (adapted from Grandjean, *et al.*, 2007). Free credits would be available to correct inequitable situations, reduced when the beneficiary's situation improved. For greenhouse gas emissions, for example, an expansion or reorganisation of public transport would justify corrective measures.

This proposed tax system could well draw upon on the **Swedish experience.** Since 1988, Sweden has introduced ecological taxes on a sufficiently large scale to make a significant impact on behaviour, and has concomitantly used the proceeds of these taxes (Grandjean *et al.*, 2007) to:

- *Reduce the tax rate on personal income and business profits;*
- *Prevent the relocation overseas of businesses particularly affected by the new taxes.*

(80) For example, the potential surplus of new tax revenue could be used for this, the surplus being calculated in relation to the tax revenue realised under the previous system, according to the principle of fiscal neutrality.
(81) The rules of the World Trade Organization are relevant here.
(82) In addition to current credit or debit cards; one for each shareholder at first, and in due course one for each consumer and / or citizen.

A **significant amount of tax revenue,** equal to 6% of the Gross National Product, **has been transferred from labour and business to the consumptions of natural resources.** As Grandjean, *et al.* (2007) point out: *"it is often said that Sweden is a small country. Does this mean that a country's ambitions for managed change are inversely proportional to its size? That larger countries are hopelessly awash in contradictory goals, administrative resistance (based no doubt on the best arguments) and all-powerful pressure groups? What Sweden has achieved would be utopian in France: but in that case, we ought to swiftly understand and acknowledge that there is nothing but this type of utopia to be realistic."* In the end, the truly utopian attitude is to believe that everything can continue on just as it is at present - like the man who jumps off the top of a skyscraper and as he falls past each storey calls out: *"so far, so good!"*

SECTION 4
INNOVATIVE INITIATIVES AROUND THE WORLD

This final section includes ten innovative initiatives for biodiversity around the world. These brief articles are closely linked to the world of business and provide some answers for building a common path towards the co-viability of biodiversity and businesses. Businesses may be the target of the initiative, privileged partners of the project or the key drivers of an economic activity which seeks to ensure the viability of biodiversity.

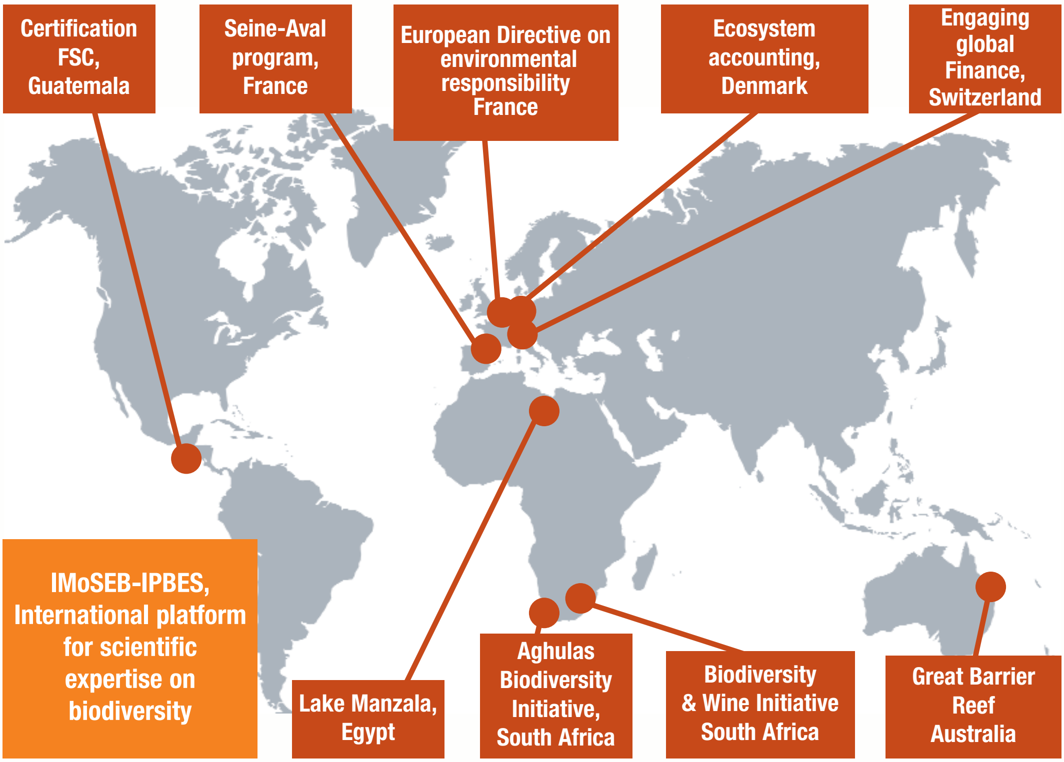


Figure 15 : Geographical locations of innovative initiatives.

4

By Susan Steinhagen, UNEP Finance Initiative

The balance between market forces and the intrinsic value of our natural wealth that underpins all development is a delicate one, which often polarises opinions. UNEP FI is seeking to understand where the financial services sector should stand on biodiversity and ecosystem services and reinforce the need for sustainable development of new markets based on natural value – whether it be from a risk perspective, or catalysing on the new opportunities that emerging markets for ecosystem services such as carbon presents.

UNEP Finance Initiative

The United Nations Environment Programme Finance Initiative (UNEP FI) is the largest public-private partnership between the United Nations and the global financial services sector. UNEP FI works with over 170 financial institutions worldwide to integrate sustainability into financial institutions' core strategies and operations. It is THE platform for banks, insurers, asset managers, pension funds and other categories of financial institutions to work together to embed best sustainability practice in the financial sector and change the way capital markets manage environmental, social, and governance (ESG) risks and opportunities.

Global Scenario

In 2000, the United Nations initiated the Millennium Ecosystem Assessment (MA) to examine the links between ecosystems and human well-being to provide a scientific basis for action. Its key finding was that ecosystem services are declining in most instances.

- Cultivated land now covers one quarter of the world's land – this has resulted in massive loss of natural habitats such as forests and wetlands and many of their associated ecosystem services;
- Demand for food is projected to increase 70-80% by 2055 and a further 10-20% of grassland and forest is projected to be converted to agriculture between 2000 and 2050. This will result in significant additional release of green house gases (GHG);
- Coastal habitats are being destroyed at an unprecedented rate – 20% of the world's coral reefs has been destroyed and a further 20% is significantly degraded resulting in the decline in availability of fish and coastal defences;
- More than a third of global mangrove forest was lost between 1990 and 2000; this, together with the loss of other coastal defences has reduced our protection against natural hazards such as hurricanes and tsunamis;
- Bees are in decline globally, linked to escalating levels of pollution and loss of habitat. Overall, 35% of the global food production from plants benefits from animal pollination. The value of all this ranges from USD 112 billion to USD 200 billion annually.

4.1.1

UNEP FI and Biodiversity & Ecosystem Services

Aware of the evolution of new markets for BES, such as conservation banking, green fiscal funds, eco-securitisation, and payments for ecosystem services to name a few, as well as a growing interest from progressive leaders in the financial services sector to make these markets work for the planet's good as well as profit, UNEP FI started its BES work stream in early 2007. The development of this work stream also follows the explicit mandate given at the 8th Conference of Parties (COP) of the Convention on Biological Diversity (CBD) in 2006 which states that parties *"Invites businesses and relevant organisations and partnerships, such as the Finance Initiative of the United Nations Environment Programme, to develop and promote the business case for biodiversity..."*

The work of this Group, driven by fourteen UNEP FI member institutions with ten leading environmental NGOs supporting in an advisory capacity, is based on the need to engage the global financial services sector in identifying and addressing the risks and opportunities associated with biodiversity loss, the degradation of ecosystem services and the sustainable use of ecosystems and the services associated with them (raw materials such as fish and timber, regulatory services such as climate or flood regulation). The lead institutions and civil society partners will explore regulatory frameworks, business operations and stakeholder concerns as the work stream unfolds.

During the scoping phase ahead of the launch of this work stream, at least three principal barriers to mainstreaming biodiversity and ecosystem services considerations in the financial services sector were identified:

- Lack of awareness of the implications of degraded ecosystems on business and the lack of capacity to respond;
- An undeveloped business case for action;
- Insufficient policies aligning financial incentives with ecosystems stewardship.

The BES work stream recently produced a CEO Briefing[1] and report "Bloom or Bust[2]" in 2007. The publication, the first of its kind for the work stream, analyses a wide array of financial linkages between banks and investors and various industry sectors by exploring the risks faced by financial institutions that as well as opportunities for financial products and services that support sustainable use of biodiversity and ecosystem services. The report also proposes actions required by the financial services sector and the policy-making community to make finance and capital markets work for – and not at the expense of – BES.

The following table[3] illustrates the risk exposure created by different financial products and services as attribution (the extent a financial institution can be held accountable for the BES impacts of a transaction) and leverage (how much a financial institution can influence client behaviour) fundamentally affect the ability of a financial institution to engage with its clients.

(1) http://www.unepfi.org/fileadmin/documents/CEOBriefing_biodiversity_01.pdf
(2) http://www.unepfi.org/fileadmin/documents/bloom_or_bust_report.pdf
(3) This figure is derived from the UNEP FI report "Bloom or Bust" a financial sector briefing on biodiversity & ecosystem services

4.1.1 ENGAGING GLOBAL FINANCE

By Susan Steinhagen, UNEP Finance Initiative

4.1.1

Table 8: Attribution of financing and investment risks to selected financial services

Products/ Services	Characteristics
Project Finance	• Site-specific and known use of funds; • Often considerable information available from environmental and social impact assessments.
Corporate Loans	• Use of proceeds may be unknown; • Requires greater understanding of general BES risks related to the sector, and client commitment, capacity and track record to manage BES risks; • Supply chain risks may require particular attention.
Investment Banking	• Use of proceeds may be for non-specific corporate development activities; • Disclosure of environmental and social risks required, to varying extent, by stock exchanges and regulators.
Fund Management	• Portfolio selection, engagement and proxy voting are increasingly important; • Proxy voting outcome is publicly available in many jurisdictions and hence there is greater transparency at least for publicly traded companies.
Trade Finance	• Limited recourse facilities to finance trade in oil, precious and base metals and soft commodities; • Commodities used as collateral to fund working capital requirements; • Commodity finance commonly used in emerging economies where BES issues are particularly apparent.

By Susan Steinhagen, UNEP Finance Initiative

Risk Attribution	Leverage Potential
High • Clear causal relationship between project financing and biodiversity impacts; • Clear materiality links between financing impacts.	**Good** • Duration of loan often long; • Leverage can be effected through financing terms, disbursement schedules and the integration of BES into covenants, disbursement conditions and project completion tests.
Variable but can be high • Level of attribution depends on whether use of proceeds is known.	**Variable** • Limited direct leverage if use of proceeds is unknown. Potentially more significant leverage where use of proceeds is known; • Reliance on client environmental and social management systems is often important.
Limited but growing • Attribution of an institution's role in financing/enabling potentially BES-damaging activities difficult, but this does not prevent civil society groups from targeting institutions that they perceive as supporting companies that have questionable BES records.	**Variable but often good** • Good leverage especially if relationship with client is long-term; • Risk of client migration to institutions with less demanding environmental requirements; • Short turn-around times for transactions may make it difficult to establish a good understanding of BES risk where information is incomplete.
Limited but growing • Attribution of fund managers accountabilities to BES have traditionally been weak; • Principles for Responsible Investment (PRI) appear likely to drive change significantly.	**Variable but can be good** • Leverage influenced by volume of shares held and capacity/appetite of fund managers to engage; • PRI (and SRI tools and experiences) provide a platform for scale up of engagement; • Large size and long-term horizon for pensions investments means they wield considerable influence and have inherent interest in long-term performance of companies (recognising that effective BES management is material to company valuation).
High • Lending related to specific commodities which incur BES impacts in their lifecycle (biofuels, cotton, base metals); • Growing evidence of biodiversity impacts associated with agribusiness (particularly biofuels) and associated with damage to ecosystem services (particularly water).	**Low but opportunities do exist** • Tenor and duration of transactions may preclude leverage (short-term, uncertain provenance and limited attribution to specific impacts); • Increasing demands for information on product sourcing (driven by food safety, environmental and social and other needs) means that chain of custody and related certification systems are increasingly being applied to commodities and attribution/leverage.

4.1.1

The Business Case

It is crucial for the financial sector to understand how the impacts of BES subsequently lead to challenges as well as opportunities. The financial services sector, in terms of lending, investing and insuring, is a key point of leverage in enabling BES loss and is also a mechanism for effecting better BES assessment and management.

The Natural Value Initiative

Practical next steps for the financial sector listed in this report include developing and promoting benchmarking of performance across the financial sector. UNEP FI is already addressing this issue through the Natural Value Initiative (NVI)[(4)] – a benchmarking tool focused on the food, beverage, and tobacco sectors. This multi-stakeholder initiative is funded by VROM, the Dutch Ministry of Housing, Spatial Planning and Environment and led by UNEP FI, leading environmental NGO Fauna & Flora International (FFI), Brazilian business school FGV and supported by the UN Principles for Responsible Investment. The tool is based on an adapted version of a tried and tested methodology already employed within the asset management community and designed by Insight Investment to evaluate the extractive sector.

The objectives of the benchmark are to:

- Build expertise in the finance sector for evaluating risk and opportunities associated with this issue;
- Build awareness of the food, beverage and tobacco sector's dependence on biodiversity and ecosystem services; and
- Stimulate improved performance in the food, beverage and tobacco sectors.

The tool will focus on sustainable land management and agriculture, with a modular approach for different levels of value chain to identify current good practice / leadership. The NVI team has secured 7 financial institutions so far to pilot the tool – Insight Investment, the Ethical Funds Company, F&C Asset Management, Morley Fund Management (UK asset managers), Pax World (US asset manager), VicSuper (Australian superannuation pension fund), and Banco Real (Brazil). The project will benchmark 30 companies and the sample of companies will be dictated by the pilot investment companies.

The tool will focus on 3 levels of supply chain: primary producers and commodity processors, manufacturers and retailers, and farm level performance, and will ask a series of targeted questions based on established risk management practice on governance, policy and strategy, management and implementation, reporting, and competitive advantage.

Key outcomes of this benchmark will include:

- A company specific analysis of strengths and weaknesses;
- A consolidated report outlining key findings from the analysis and ranking those companies benchmarked to show leading and lagging practice;
- A document outlining the business case for managing biodiversity and ecosystem services dependencies and impacts; and
- A biodiversity and ecosystem services dependency and impact benchmarking tool promoted to investors for uptake and repeat analysis.

(4) www.naturalvalueinitiative.org

By Susan Steinhagen, UNEP Finance Initiative

The NVI ultimately hopes to achieve greater awareness within the finance sector of the business case for managing biodiversity & ecosystem services, the risks associated with mismanagement, and understanding of best practice and capacity to effectively manage biodiversity risk.

Is the market starting to transform?

In the past few years, there has been a significant shift in the way the financial sector has addressed ESG issues. The Freshfields report[(5)], a 150-page UNEP FI study developed by leading law firm Freshfields Bruckhaus Deringer has redefined the debate linking fiduciary duty with ESG issues as well as the traditional market's view of how fiduciary law relates to ESG issues. UNEP FI has also produced reports on the scope for ESG issues including BES in asset management of high-net-worth individuals[(6)], lending[(7)], and insurance[(8)]. These reports are evidence that the mandates put out by the world's largest investors are increasingly integrating ESG issues such as BES. At the G8 environment meeting in Potsdam in March 2007, the environment ministers of the G8 countries together with their counterparts from Brazil, China, India, Mexico and South Africa agreed on a "Potsdam Initiative" to estimate the economic costs of global biodiversity loss. There was a clear message to the financial sector to *"effectively integrate biodiversity into its decision making..."* This is a strong indicator of potential policy change, which will help enable a common basis for action within the financial services sector.

The UN Principles for Responsible Investment, an investor initiative in partnership with UNEP FI and the UN Global Compact, launched in April 2006 by the then UN Secretary General Kofi Annan, is a clear signal that many investors are beginning to embed ESG issues into policy-making and decision-making. This initiative, with over 300 institutional investors from 30 countries representing USD 13 trillion in assets, is now also endorsed by the present UN Secretary General Ban-ki Moon. Through its support of the NVI, the PRI is proving to be a significant entry point for many financial institutions into the biodiversity space. The PRI Engagement Clearinghouse is an example of investors stimulating collaboration and addressing problems that need collective action.

Indeed, the financial sector's greatest environmental and social challenges – especially in these current turbulent times – are also its most promising opportunities.

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(5) http://www.unepfi.org/fileadmin/documents/freshfields_legal_resp_20051123.pdf
(6) http://www.unepfi.org/fileadmin/documents/unlocking_value.pdf
(7) http://www.unepfi.org/fileadmin/documents/infocus.pdf
(8) http://www.unepfi.org/fileadmin/documents/insuring_for_sustainability.pdf

4.1.2

Harvesting in the wild

Southern Africa is a major repository of floristic diversity. It harbours some 24,000 plant species, equivalent to 10% of the world's species in an area of less than 1% of the planet's surface area. South Africa counts as a Megadiverse Nation, one of the 17 most biodiverse countries on the planet. The country has seven major biomes: the Cape Floristic Region (CFR), the Succulent Karoo, the Nama Karoo, the Thicket Biome, Grasslands, Afromontane forest and Savannah. Of these the Cape Floristic Region (CFR) is the richest floristically, home to an estimated 9,600 plant species of which 70% are endemic. The CFR is one of six Plant Kingdoms globally, and the only one found entirely within the boundaries of a single nation. Spanning an area of 90,000 square kilometres in the southern-most region of South Africa, the CFR is a winter rainfall area enjoying a temperate Mediterranean climate. The area is characterized by a narrow coastal plain, and a mountainous interior encompassing the dissected Cape Fold Belt Mountains. The vegetation is dominated by fine stemmed plant communities adapted to the nutrient poor soils known as fynbos (literally: fine bush). Fynbos in turn is dominated by four plant families, the proteas (protaecae), ericas (ericaceae), and restios (restionaceae) and the daisies (Irididaceae) – the latter being the most species rich of these. Interestingly, the Fynbos is the centre of origin of many popular garden flowers, particularly bulbs such as gladioli, freesias, watsonias, Ixias and arum lilies. The country produces bulbs for the domestic market and for export, though indigenous bulbs are now mainly cultivated overseas, for example in New Zealand. The Fynbos is also a source of flowers harvested for the growing cut flower export market and domestic consumption.

Cut flower industry

The cut flower industry in South Africa is still relatively small by world standards, accounting for only 0.3% of the world's total exports[9]. Veld-harvested wild flowers constitute a subset of this industry. This activity is based predominantly on the production and harvest of fynbos. While a number of wildflowers are now cultivated, particularly the high value proteas such as the King Protea, a large proportion of wild flowers and green foliage from the Fynbos is harvested directly from the wild.

The industry is fairly profitable and potentially also conservation compatible. If margins for wild products could be improved, the incentive to retain wild lands could head off conversion to other farming practices. Historically, fynbos veld has been deleteriously affected by a number of factors, either because flower cultivation has resulted in the conversion of wild lands to mono-typical agriculture, or because wild flower harvesters selectively removed commercially valuable target species from the ecosystem. The industry has also had a weak record of social responsibility. Although a major provider of employment in areas such as the Agulhas Plain where flower harvesting has been a traditional livelihood for decades, the business is characterised by low margins and seasonality, and picking operators have been hard pressed to pay reasonable wages and provide secure employment.

(9) International Trade Statistics (ITC) based on COMTRADE data 2001-2005, UNCTAD/WTO.

4.1.2 HARVESTING WILD FLOWERS TO SAFEGUARD BIODIVERSITY, SOUTH AFRICA

By Lesley Richardson and Nik Sekhran, Aghulas Biodiversity Initiative

Threats to biodiversity

The CFR generally is threatened by the conversion of wild lands to agriculture, for viticulture, cultivation of cereals and potatoes, and husbandry of ostriches. It is also threatened by cluster development in urban and peri-urban areas, particularly along the coast. Invasion by alien plants, in the form of Australian acacia, eucalypts and others, and uncontrolled wild fires place further pressure on the ecosystem. While the fynbos is adapted to fire, with many species dependent on it for regeneration, an increase in the frequency and intensity of fires in recent years has retarded vegetative recovery. Fires also have a disproportionately negative impact on the wild flower harvesting industry, causing landholders to sustain major losses for 3-5 years during the post fire recovery period. Even under ideal conditions it takes at least that long for fynbos veld to be productive and ready for responsible harvesting.

Off to market

Barriers to sustainable harvesting

On the Agulhas Plain - an area of 270,000 hectares of coastal lowland fynbos at the southern tip of Africa, a strong partnership has been in the making for the past 3-4 years between those in the conservation, farming and business communities in order to promote land use that is compatible with conservation and develop incentives for this. The "Agulhas Biodiversity Initiative" (ABI) links Flower Valley Conservation Trust (a local NGO), South African National Parks, CapeNature (the provincial government conservation agency), the Department of Agriculture and local authorities with landowners, picking operators and cut flower exporters in a long-term effort to manage the rich biodiversity of the area and simultaneously assist local communities to improve their quality of life.

The partnership has had the support of a number of agencies (GEF, the UNDP and the World Bank), NGOs (FFI, Table Mountain Fund and WWF), and corporate supporters (Shell Foundation, Marks and Spencer's, Pick 'n Pay Ackerman Foundation). It has made good headway in setting up a system of safeguards and incentives so as to promote business and livelihoods while safeguarding the natural capital on which businesses and communities depend. However, a number of barriers are hampering the sustainability of the wildflower industry. At the production end these include:

- *Ill-defined off take levels;*
- *Weak regulatory and enforcement regimes* that should ensure compliance with management best practices.

4.1.2

Regarding distribution and marketing, other barriers include:

- The *absence of coordinated supply networks* to draw products from large areas to avoid localised over-harvesting;
- The *lack of market access* for a product which provides sufficient returns to landowners to compensate for the added management effort needed for certification.

Safeguards and incentives

The Flower Valley Conservation Trust, a Non-Governmental Organisation, was established in 1999 to undertake research, training and monitoring in this sector. Sustainable off-take levels for certain guilds of species have now been established through field work by expert botanists, applying the precautionary approach to reduce harvesting risks. A recording protocol is in place, a species identification schedule is now available, and a data capture system has been established. A Code of Practice for flower harvesting has been developed. The regulatory authority, CapeNature, is now granting veld harvesting permits largely on the basis of this Code. In addition, an auditing and certification system, with an associated brand and marketing strategy, is being developed. In due course, the brand should generate premium returns for certified harvesters and exporters, which would encourage them to harvest wild flowers in an environmentally sustainable and socially responsible way.

Over 80% of the land on the Agulhas Plain is in private ownership. At the start of ABI, only 14% of the Agulhas Plain was under legally binding conservation status. Though stewardship agreements with landowners and the expansion of the Agulhas National Park this figure now stands at 37% (102,000 Ha). At least 40% of this surface area is on privately owned productive landscapes, reinforcing the important role of the agricultural sector to conservation. The areas harvested by certified flower pickers have made a big contribution - sustainably harvested wild flowers are now being sourced from an area of 30,000 hectares, the natural habitat of which is being maintained as a consequence.

Product Sourcing and Distribution

In 2003, a private company, Fynsa Pty Ltd, was set up with capital from private investors to source and market sustainably harvested wild flowers to overseas and domestic markets. Fynsa has entered into a partnership agreement with the Flower Valley Conservation Trust in support of its efforts to sell product directly to retailers to maximise price returns at the farm level. It is hoped that this will increase conservation incentives for producers. After three years in operation, Fynsa registered annual sales of over US$5 million in 2007, with sales growing by up to 40% year on year over the previous year. A major marketing deal has been secured with Marks and Spencer's in the UK, which sells and promotes the flowers under its social responsibility programme. A new marketing deal is being negotiated with South African grocers Pick 'n Pay, to diversify into the local market. A partnership has also been established with the UK-based Better Flower Company to diversify overseas markets.

By Lesley Richardson and Nik Sekhran, Aghulas Biodiversity Initiative

Bouquets in the making

Social "profits" and the Triple Bottom Line

As a direct result of this increased business through Fynsa, employment figures amongst certified flower picking operators and Fynsa's packsheds have doubled in the last three years. All operators are audited against minimum labour and employment conditions, and are required to implement an improvement plan and, ultimately, to be certified. A baseline survey is also done for each supplier so as to document additional social aspects such as health and welfare statistics, access to services and education.

Indeed, the long-term goal is achieving positive change over time in the livelihoods of communities as a result of improved market access and better margins. For only then will it be possible to say that the business of harvesting fynbos is truly sustainable, based on "Triple Bottom Line" principles.

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4.1.3

Deterioration of water quality in the drainage network of the Nile Valley and Delta in Egypt is a major concern, with the lack of wastewater treatment facilities regarded as the chief culprit. Traditional systems require significant initial investments and high recurring costs for operation and maintenance. The government is thus unable to provide populations with efficient wastewater treatment solutions, especially in rural areas.

Lake Manzala holds a particularly poor water quality. Five major drains carry irrigation flows to the lake which eventually discharges to the Mediterranean Sea west of Port Said and the Suez Canal (figure 16). The Bahr El Baqar Drain is the largest and most polluted. Travelling 150 kilometres from Cairo to Lake Manzala, it drains approximately 270,000 hectares, with an average flow of approximately 3 million m^3/day, and carries nutrients, metals, organic and toxic compounds from municipal, industrial and irrigation discharges, among other sources of pollution.

Moreover, polluted water from Lake Manzala threatens the Mediterranean Sea. Over the last 50 years, more than two-thirds of the Lake's surface area has been lost due to inflowing sediment and subsequent land reclamation. Dissolved oxygen levels have depressed and aquatic diversity has declined. The once diverse fishery that sustained the rural population has mostly collapsed while the incidence of water related diseases has significantly increased.

By Dia El Din El-Quosy, Lake Manzala engineered wetland project

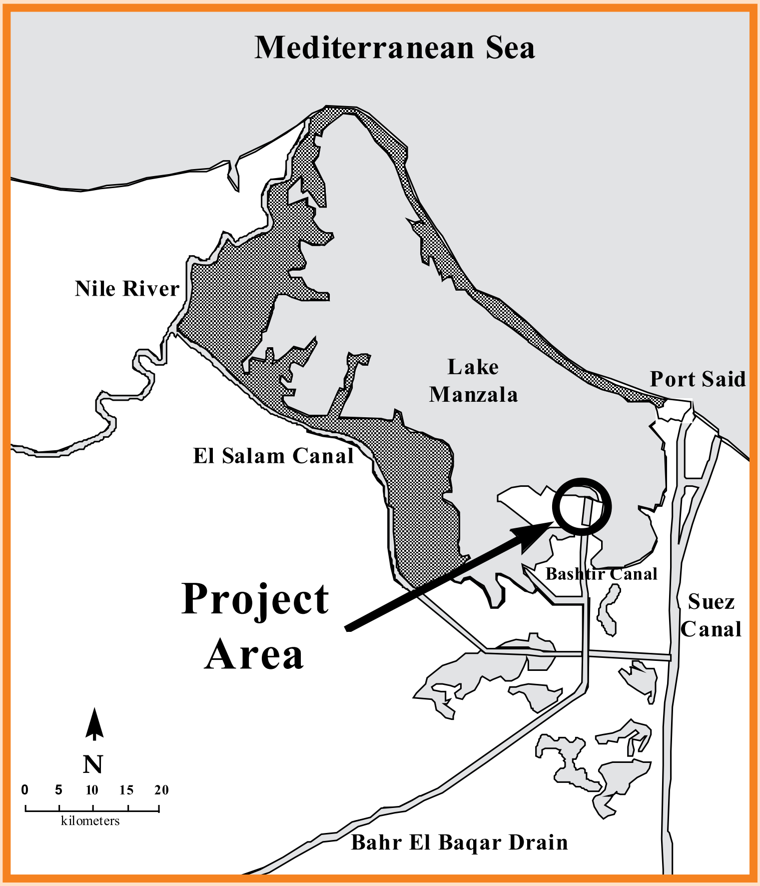


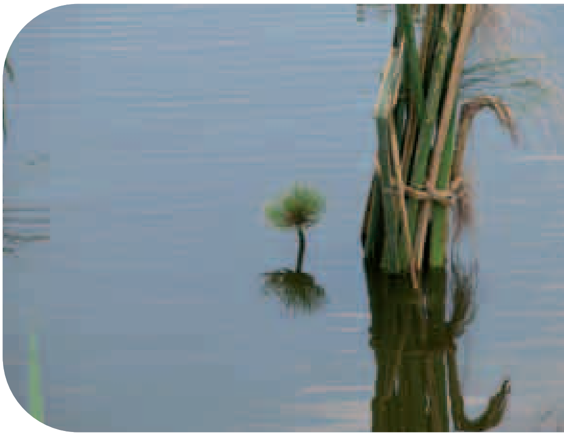
Figure 16 : Lake Manzala, project area

4.1.3

In order to improve water quality, efforts have been made to improve wastewater treatment facilities for municipal and industrial pollution, primarily in Cairo. If various alternatives have been considered for treating polluted drain water before it enters the lake, the Lake Manzala Engineered Wetland Project is the only one that has progressed to the demonstration phase. It involves a cooperative effort among the Global Environmental Facility (GEF), the United Nations Development Program (UNDP) and the Ministry of State for Environmental Affairs (EEAA).

The Lake Manzala Engineered Wetland Project investigated the suitability of using engineered wetlands as a low-cost alternative for treating sanitary sewage from cities, towns and villages located on the desert fringes of the Nile Valley and Delta, where ample land area is available. Experts recognize that natural wetlands can greatly improve water quality. When water enters at one end of the natural wetland loaded with a high concentration of heavy substances and toxins, it leaves the other end with reduced loads of these contaminants and pollutants, most of which are taken up by the reeds. The purposes of the project are to:

- Assess the feasibility of wetland treatment systems for improving drain water quality, public health, and the aquatic ecology of Lake Manzala;
- Promote sustainable development by enhancing environmental and economic opportunities at the local and national level;
- Assist in transferring wetland treatment technology to Egypt.



The project will provide engineering and economic data for possible wider use of wetland treatment systems in the country. It is also designed to provide local employment and to serve as an excellence and training centre for water management and wastewater treatment technologies. Project planning, design, construction, and operation are to be accomplished so as to maximize Egyptian participation and self-sufficiency in wetland treatment technologies.

By Dia El Din El-Quosy, Lake Manzala engineered wetland project

Design criteria

An engineered wetland is a shallow basin filled with a relatively impermeable substrate, usually soil or gravel, and planted with vegetation tolerant of saturated conditions. Water is introduced at one end and flows over the surface, and is discharged at the other end through a structure which controls the depth of water in the wetland. The selection of aquatic plants – such as cattail, papyrus, and other reeds – along with the slope of the substrate determine the speed at which the water flows through the engineered wetland and consequently the extent to which it is cleansed through its passage.

Improved water quality into Lake Manzala and the Bahr El Baqar Drain is expected to lead to economic and health benefits for the region. The ability of wetland treatment systems to handle variable inflow quality is also an advantage over traditional treatment systems; indeed, drain flow and water quality can fluctuate significantly due to varying water use and discharges along the drain.

TABLE 9:
DESIGN CRITERIA FOR INFLUENT WATER QUALITY[10]

Parameter	Units	Value
Daily flow	m^3	25,000
Total BOD	mg/L	40
Total COD	mg/L	100
Total suspended solids	mg/L	160
Total phosphorus	mg/L	5
Total nitrogen	mg/L	12
pH		7.5
Conductivity	dS/m	4

(10) Drainage Research Institute, 2000. A water quality survey for Bahr El Baqar Drain from September 1999 to February 2000. Arab Republic of Egypt. Ministry of Public Works and Water Resources.

4.1.3

Artificial or engineered wetlands can provide a low cost technology for treatment of large quantities of water that can be reused in irrigation. The technology is also suitable for fish farming through the closed cycling of treated water, replenished only to compensate for evaporated water. The wetland system will also evaluate opportunities for commercial harvesting of biomass, so that the toxicity of plants materials would need to be assessed. During high flows, the drain carries large quantities of suspended sand, silt, and clay which become adsorption sites for dissolved metals and other contaminants. Table 10 shows the partition of selected heavy metals in the water and sediments. Since the sediment carries a large fraction of heavy metals, the sedimentation basin will provide a primary pre-treatment by sedimenting contaminants before the water enters the wetland's cells. Parallel cells and flow barriers will be used to prevent short circuiting and to facilitate sediment removal. Sediment accumulated there will be dredged and removed to drying beds for sun drying (approximately 900 cubic meters per year). The dried sediment will ultimately be tested for contaminants and, if found suitable, used as construction materials.

TABLE 10:
SELECTED HEAVY METALS IN WASTE AND SEDIMENT

Metal	Unit	Zn	Mn	Fe	Pb	Hg	Cd
Water	ppb	0.076	0.35	0.45	0.32	0.37	0.40
Sediment	ppm	164.21	481.70	2.45	95.3	0.44	0.15

By Dia El Din El-Quosy, Lake Manzala engineered wetland project

Table 11 gives an overview of the parameters of each component, while table 12 summarizes the estimated effluent concentration and removal efficiency. Since removal efficiencies vary according to effluent quality, plant conditions, seasonal and site characteristics, the values shown in table 12 are preliminary estimates of treatment levels, based on the first-order removal models and empirical data provided by Kadlec and Knight (1996)[11]. One of the purposes of the demonstration project is to determine removal efficiencies under local conditions.

TABLE 11: CONCEPTUAL DESIGN CRITERIA FOR TREATMENT SYSTEM COMPONENTS

Parameters	Units	Sediment Basin	Wetland Treatment		Reciprocating ponds	Hatchery ponds	Fingerling Ponds
			High flow	Low flow			
Flow	m^3/d	25,000	21,500	3,000	500	50	450
Volume*	m^3	50,000	25,000	25,000	1,000	700	11,250
Area	m^2	33,000	50,000	50,000	2,100	640	10,300
Depth	m	1.5	0.5	0.5	1.2	1.1	1.1
Detention	day	2	1,2	8,3	2	14	25

* Active water storage volume, excluding sediment storage, plant biomass, gravel volume and unavailable reciprocating volume.

(11) Kadlec, R. H., Knight, R. L., 1996. Treatment Wetlands. CRC Press, Inc. – Lewis Publishers.

4.1.3

TABLE 12: ESTIMATED EFFLUENT CONCENTRATIONS AND REMOVAL EFFICIENCIES

	Sedimentation Pond			Reciprocating Treatment System		
Parameter	Influent conc. mg/L	Effluent conc. mg/L	Removal Efficiency %	Influent conc. mg/L	Effluent conc. mg/L	Removal Efficiency %
TSS	160	32	80	32	8.0	75
BOD	40	24	40	24	2.4	90
Total P	5	4	25	4	2.0	50
Total N	12	12	0	12	1.2	90
Organic N	4	4	0	4	0.4	90
Ammonium N	5	5	0	5	0.5	90
	High Flow Wetland Treatment*			Low Flow Wetland Treatment*		
Parameter	Influent conc. mg/L	Effluent conc. mg/L	Removal Efficiency %	Influent conc. mg/L	Effluent conc. mg/L	Removal Efficiency %
TSS	32	8.4	74	32	4.8	85
BOD	24	19.3	20	24	6.4	72
Total P	4	3.4	15	4	1.4	65
Total N	12	10.3	14	12	3.9	68
Organic N	4	3.8	5	4	1.9	53
Ammonium N	5	4.1	18	5	2.0	60

*Flow rates may vary between treatment cells: the values shown for the high flow conditions are based on a 21,500 cubic meter per day flow through Cells 1 to 5; the values for the low flow conditions are based on a 3,000 cubic meter per day flow through Cells 6 to10.

By Dia El Din El-Quosy, Lake Manzala engineered wetland project

Treatment system components

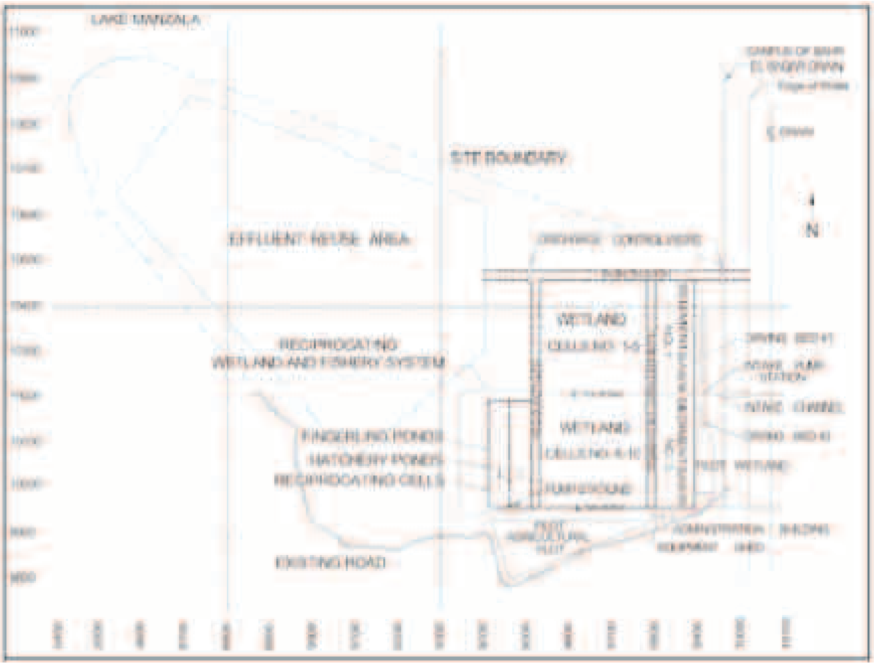


Figure 17 : Conceptual site plan for the Lake Manzala Wetland.

The project includes a 250 cubic meter per day pilot wetland system that contains most of the components of the larger demonstration facility. This allowed small-scale testing of design, construction, and operational concepts prior to the completion of the larger facility, then providing a leaning model for co-operators. Ultimately, the pilot facility will serve as a research object for future experiments that support the overall operation.

- *An intake channel with a pumping station*
  The intake channel will selectively withdraw water from the upper half of the Bahr El Baqar Drain. Two screens and a floating baffle will prevent larger materials from entering the treatment system. Then, two 12,500 m^3/day pumps will lift the water 3 meters higher into the sediment basins and provide hydraulic gradient for gravity flow through the rest of the system

- *Two sedimentation basins*
  The sediment basins provide primary treatment: At this point, the sludge is periodically removed to conventional drying beds and disposed in accordance with environmental regulations. At this stage of the process, most of the metals are removed.
- *Ten surface flow wetland treatment cells*
  Effluent from the sediment basins then passes through ten surface flow cells. Each cell is divided into five compartments planted with reeds *(Phragmites communis)* common to the Lake Manzala area. Cattail, water hyacinth, duckweed, and bulrush will also be tested in some cell sections. These plants have the ability to absorb and store pollutant in a process called phytoremediation. In order to test removal efficiencies at different flow rates, five cells will initially be set as "low flow cells", and five others as "high flow cells". The first ones, with a capacity of approximately 3,000 cubic meters per day, have loading rates similar to conventional wetland systems while the others (approximately 21,500 cubic meters per day) will assess the potential of maximum loading rates that might be used to treat a larger portion of the Bahr El Baqar Drain. Flow control devices will allow research to be undertaken with respect to a variety of flow rates, plant types, and operational arrangements.
- *Two reciprocating subsurface flow treatment cells*
  The next step consists in two reciprocating subsurface flow cells (500 cubic meters per day) designed to treat effluents from the sediment basins. Alternatively, effluent from the surface flow cells can be used to supply the reciprocating cells. Two pumping stations will be used to reciprocate water between the two. Finally, the cells will be filled with graded gravel and will produce an effluent suitable for supplying inflow to a fish-rearing facility.
- *A fishery facility*
  It includes four hatchery ponds, followed by two fingerling production ponds, and is expected to produce one million tilapia fingerlings per year. The facility will demonstrate that drain water can be sufficiently cleaned so as to maintain a safe and cost-effective aquaculture.
- *Water distribution and outflow channels*
  So as to minimize costs, earth embankment channels are used for water transfer. Beyond the sediment basins, a distribution channel conveys water to the surface flow wetland cells. Beyond these cells, an outflow channel returns the treated water to the Bahr El Baqar Drain or to the effluent reuse area. Weirs are used throughout the facility for flow control and measurement.
- *Effluents reuse area*
  Approximately 40 hectares of the 100-hectare site are allocated for effluent reuse. Their purpose is to demonstrate that effluent recycling can promote economic activities and enhance job creation. Treated water will be used for agricultural crops and fish ponds.

By Dia El Din El-Quosy, Lake Manzala engineered wetland project

Status of the project: Management and monitoring

The operational phase of the project started in early 2005. The operation and maintenance of electro-mechanical equipments for both the pilot and the main facilities are under the management of the Mechanical and Electrical Department (MED) of the Ministry of Water Resources and Irrigation. The first two years have been dedicated to operational research, training, and monitoring. The monitoring program has included four data collection and assessment activities[12]:

(1) Operational monitoring will provide information for operating the facility: site conditions, equipment run times, maintenance records, costs, trouble reports, and water flow rates and conventional treatment parameters at key locations within the system.

(2) Performance monitoring is designed to assess the treatment efficiency of individual system components. Inflows and outflows, sediment, and the by-products of each component will be monitored for conventional parameters, such as concentrations in metals, organic particles, as well as presence / concentration of bacteria and parasites.

(3) Research monitoring purposes aim to improve operations and technology, as well as to diffuse knowledge regarding wastewater treatment by artificial wetlands.

(4) Environmental impact monitoring will assess the potential effects of the project: construction and groundwater impact assessments, socio-economic and health risk assessments.

Challenges and perspectives

For the first time in Egypt, an engineered wetland treating 25,000 m^3/day of polluted water has been constructed. This technology offers a cheaper alternative to conventional wastewater treatment: it does not require any chemical substances and has low maintenance needs. Artificial wetlands could prove to be the solution for domestic sewage treatment in developing countries, provided design criteria and parameters are adapted to local conditions. So as to provide the necessary information for replication, the project will need continual evaluation through an intensive monitoring program. Within that context, two major challenges have been identified so far:

- the difficulty of replication when land is not available;
- the removal of sediment and plant residues.

If sediments can be used for the production of bricks or ceramics, while plant biomass is freed from toxic elements, the second challenge may be converted into an opportunity.

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(12) Komex G. T., 2000. Lake Manzala Engineered Wetland: Performance Monitoring Report.

4.1.4

Key ecological data

- The Great Barrier Reef (GBR) fringes the north-east Australian coast for approximately 2000 km and comprises over 3200 coral reefs embedded in an ecosystem that includes mangrove forests, coastal wetlands and estuaries, seagrass meadows, deep shoals, continental shelf margin and slope. It is the world's largest World Heritage Area.
- Indirect ecosystem services provided by the GBR include shoreline protection, maintenance of biological diversity, waste reception and assimilation, and visual amenity.
- The GBR was declared a Marine Park in 1975. It is managed using a multiple use approach in zoning plans; approximately 30% across all 70 bioregions that make up the GBR ecosystem is currently in highly protected, no-take zones.
- The total population of GBR catchments is around 1 million, some 20% of Queensland's population. Low densities in the order of 2.2 persons per km^2 apply over much of the area but the urban centres of Townsville, Cairns, Mackay, Rockhampton, Gladstone and Bundaberg and adjacent coastal areas are growing rapidly – absorbing much of the 1.2% average population increase for the region. There has also been significant growth around mining developments.

Key economic data

- Industries in the GBR catchments, and activities within the GBR, generate a significant portion of Queensland's regional economy.
- Tourism is a major contributor to the regional economy (AUD$3.8 billion). Tourism has by far the largest growth rate for any industry and is predicted to nearly double in value within 20 years.
- The Great Barrier Reef Marine Park welcomes nearly 2 million tourists and 4.9 million recreational visitors each year.
  The GBR region contributes over 60 per cent of Queensland's exports from ports.
- The total (direct plus indirect) economic contribution of tourism, commercial fishing, and cultural and recreational activity in the GBR and its catchments to the Queensland economy is AUD$5.4 billion per annum (gross product) and employs about 56,000 persons.
- The combined farm-gate value of production from GBR watersheds is above AUD$3.8 billion. Including processing and other secondary activities, the total value of agriculture is estimated to be around AUD$15.3 billion.
- Including tourism, the value of industries that are totally reliant on the natural resources of the Reef and its watersheds exceeds AUD$22 billion per annum.

By David Osborn, Great Barrier Reef Marine Park Authority

Johnston River mouth near Innisfail, North Queensland

The Great Barrier Reef Marine Park Authority (GBRMPA) is a statutory agency of the Australian Government. Its long-term goal is to provide for the long-term protection, ecologically sustainable use, understanding and enjoyment of the Great Barrier Reef through the care and development of the Great Barrier Reef Marine Park.

To the residents of Queensland, and Australia more broadly, the GBR provide a cultural backdrop, a renewable food supply, a tourism bonanza, a transportation highway, a biotechnology supermarket, and many more benefits that must be protected through timely and effective intervention by governments, industry and civil society working in partnership.

A Partnership Approach

Like many reefs around the world, the GBR is under stress from 3 main influences: over-harvesting of resources, climate change and terrestrial runoff of pollutants. These influences have a combined effect and the ecological resilience of GBR is at the mercy of social, business and regulatory norms that dictate human behaviour not only in the Marine Park, but also in the adjacent watersheds (water quality) and globally (climate change). The management of the GBR therefore demands multidisciplinary and cross-sectoral partnership approach.

In this context, a central philosophy of the GBRMPA is that the management of impacts and the achievement of sustainable use must *actively* involve the people whose use and activities relate to the Marine Park. However, the GBRMPA acknowledges that industry must also respond to demands from the consumer, the broader community, investors, retailers and suppliers, and the financial community. Companies, even entire sectors, must consider their reputation, political networks, employees and customers, operations, partner or parent companies and financial viability. Consequently the partnership approach encouraged by the GBRMPA is a process of shared learning over long periods of time.

4.1.4

Cane farming in the Tully area, North Queensland

Partnering with the Agricultural Sector

The management challenge in the GBR watersheds is essentially to reduce diffuse pollution, from many individually managed enterprises, over a large area. There is room for some intervention to address accumulated pollution but the primary accent has to be on change at the enterprise level.

There is a strong need to understand the complex biophysical interactions between land and GBR ecosystems and to assess the economic and social realities, costs and benefits of the change needed for protection.

The Reef Water Quality Partnership (RWQP) was formed in 2006 to improve cooperation and collaboration between Australian and Queensland Government agencies, including the GBRMPA, and the regional community-based Natural Resource Management (NRM) bodies of the GBR, to address the common science needs for targets-setting, monitoring and reporting, and to facilitate cross regional consistency in approaches to managing water quality issues for the GBR.

Regional community-based NRM bodies have an increasingly important role in catchment management in Queensland and nationally. These groups lead the development of integrated Regional NRM plans which are accredited by Commonwealth and State governments. The plans are required to utilise the best-available science and involve strong community participation. Regional NRM plans are characterised by a hierarchy of targets that articulate management action and resource condition objectives for natural resource assets. Delivery is facilitated through partnerships between the regional NRM bodies and a range of other institutions (including all levels of government) and individual land managers.

In Queensland the sugarcane industry has embraced a concept of Farm Management Systems (FMS) which incorporates "best practice". This includes the development of a set of easy to use voluntary support tools which sugarcane growers can use to improve cane farming practices and farm profitability while addressing the industry's environmental duty of care.

Sediment control in the grazing industry is guided by an industry led initiative, Grazing Land Management (GLM). This initiative has developed regionally specific BMPs. Sediment control in these areas requires increased vegetation cover to retain water, sediments and nutrients on the land. In principle, this means reductions in utilisation rates of vegetation through reductions in stocking rate, particularly during the wet season (wet season spelling) and forage budgeting. However, recent research suggests that the majority of the sediments flowing into the creeks and rivers come from stream-bank and gully erosion, which will sometimes need engineering solutions rather than changes in grazing land management. Current practices largely address hill-slope erosion and further work is required on management and restoration techniques for gully erosion. Maintaining soil health, for example through reduced stocking pressure, is also identified as an important contribution to improving soil infiltration, and therefore, reducing surface water runoff and sediment loss.

By David Osborn, Great Barrier Reef Marine Park Authority

Great Adventures pontoon on Norman Reef

Partnering with the Tourism Sector

The Marine Park tourism industry of North Queensland is based on the iconic status of the GBR. The future well-being of both the Marine Park and the tourism industry are inextricably linked – a healthy Marine Park tourism industry will always need a healthy Great Barrier Reef to present to its visitors.

The increasing realisation of this interdependence has led to the development of a strong and active partnership between the GBRMPA and the Marine Park tourism industry. This partnership directly helps achieve a well-managed and sustainable industry as well as significantly improving environmental, cultural and business outcomes in the Marine Park.

Key outcomes of the partnership include:

- An increased focus by tourism operators on site stewardship, and the link between care and protection of the Marine Park with their business success;
- Enhanced visitor experiences and understanding of Marine Park values;
- A network of tourism sites monitored by tourism operators and crew, with information used in Marine Park management decisions and tourism interpretive programmes; and
- Increased on-water compliance reporting.

All tourism operators are required to have a permit to operate in the Marine Park. It describes the type of operation that may be undertaken and enables a tailored approach to individual business needs. The GBRMPA has worked closely with industry to make its permitting arrangements more business-focussed and responsive, significantly improving operator satisfaction. The 'one-stop-shop' arrangements for permitting mean that an operator can be granted access to both the Great Barrier Reef Marine Park and the adjacent State Marine Park on the one piece of paper.

As part of its High Standard Tourism Program, the GBRMPA offers certified operators the opportunity to increase the term of their permits from the standard six years to fifteen years. This longer term delivers significantly improved certainty for operators, some of whom have invested tens of millions of dollars in infrastructure in the Marine Park.

Partnership monitoring programs, such as Eye on the Reef, BleachWatch and water quality monitoring, give tourism operators the opportunity to directly monitor their sites and for that information to contribute to management. This is a growing and very rewarding avenue for operator involvement in Marine Park research and management.

Partnering with the Fisheries Sector

There are four main groups who fish in the Marine Park (commercial, recreational, charter and indigenous) using a range of gear types including trawling, netting, line, pots and hand collection. Fishing in the Marine Park is primarily managed through a range of input (effort) and output (harvest) controls regulated by the Queensland State government, not the GBRMPA. However, the multiple-use zoning system further regulates fishing activities by controlling access. Access to each type of zone depends on the level of impact caused to the ecosystem by different fishing methods. More than 30% of the Marine Park is closed to all forms of fishing.

4.1.4

While a comprehensive fisheries partnership agreement is still being developed, all stakeholders acknowledge that the way forward, particularly in the face of climate change, will need to be adaptive, flexible and collaborative.

A good example of such a collaborative approach has been the development of best practice management arrangements for the commercial coral fishery. Corals are taxonomically complex and this very small, quota–based, hand collection fishery is worth about $5 million. It services the personal and public aquarium markets and includes a small export component.

Careful scientific evaluation identified that, when managed appropriately in a healthy coral reef environment, this fishery is very low impact, high value and can play a significant educational role in showcasing coral ecosystems to people who would not otherwise get to snorkel or dive on coral reefs. Noting that conservation is best achieved through awareness and understanding, this evaluation provided the impetus to collaboratively proceed with developing world's best practice management. Over several years the framework has been built on:

- extensive consultation, across governments, agencies and stakeholders;
- inclusive bottom-up development of the details, to foster stewardship and facilitate compliance;
- developing a large toolbox, including fisheries policy and licensing conditions, novel expert and consensus-based approaches to ecological risk assessments for multi-species fisheries, good compliance capability plus GBR marine park zoning and permitting,
- regular review to ensure the process will be responsive and continually improved, and
- recognition that the fishers are in the water regularly, often going to parts of the GBR that others do not, so they are an important source of knowledge about the GBR for managers.

This approach has been so effective that the coral fishers have continued their stewardship focus and are working in partnership with managers and other user groups to build an auditable environmental management system for their industry, similar to that of the high standard tourism program. This approach will enable the fishers to market their product under an eco-certified label. Also, it is likely to be the first example of fishers explicitly and voluntarily developing best practice collection strategies to address a range of potential climate change impacts.

Conclusion

A long-term objective of the GBRMPA's partnership approach to management is that stakeholders, such as agricultural landholders, tourism operators and fishers, will shift from being *reactive*, a defensive approach to government regulation, to being *proactive*, by internalising conservation and protection of the GBR as an element of quality management.

4.1.4 BUILDING PARTNERSHIPS WITH BUSINESS FOR AN ECOSYSTEMIC APPROACH TO MANAGING THE AUSTRALIAN GREAT BARRIER REEF, AUSTRALIA

By David Osborn, Great Barrier Reef Marine Park Authority

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4.1.5

After more than fifteen years' work[13], on 21 April 2004 the European Commission adopted Directive 2004/35 on responsibility for the prevention and remediation of damage to the environment. The French law adopting provisions of the Directive, passed by Parliament on 1 August 2008 and published in the *Journal Officiel* of 2 August, is based, like the Directive, on the "polluter pays" principle[14] and implements Articles 3 (principle of prevention) and 4 (principle of compensation) of the Environment Charter previously appended to the Constitution. It amends the Environmental Code by adding Title VI, *"Prevention and repair of damage to the environment"*, to Book I.

Bearing of the Directive

The only damage concerned is that directly or indirectly caused to the soil, surface water and groundwater in the course of occupational activity, as long as a causal link can be established between the damage and the activity in question. Emissions, events or accidents occurring prior to 30 April 2007, the date on which the Directive came into force, are not covered, nor is damage to protected species and natural habitats resulting from an act by an operator which was expressly authorised by the appropriate authorities. The operator of the activity causing or likely to cause damage to the environment must at its own expense take preventive or remedial measures, whether it is at fault or not.

The risky or potentially risky activities listed in Annex III of the Directive are subject to a no-fault liability regime for damage to soil, water, protected species and natural habitats. All activities other than those listed in Annex III fall under an at-fault or negligence liability regime, limited to the actual damage or imminent threat of damage caused to species and natural habitats protected by Community legislation.

Article 8.4 of the Directive of 21 April 2004 specifies that the Member States may introduce legislation to exempt the operator from the cost of remedial actions under either of two conditions: where it had a permit for the activity in question or where "risk in development" arises. In the latter case the operator must (a) demonstrate that it was not at fault or negligent and (b) that the environmental damage was caused by an emission, event or activity which:

- either was authorised under applicable national laws, all of whose conditions have been complied with,
- or was not considered likely to cause environmental damage according to the state of scientific and technical knowledge at the time when the activity took place.

The deadline for incorporating the Directive into national law was set as 30 April 2007. In June 2008 the Commission initiated proceedings against nine Member States[15] for failing to incorporate the Directive. France has since partly incorporated it by passing the law of 1 August 2008.

(13) Green Book of 14 March 1993, on the remediation of damage caused to the environment, COM(93) 47 final; White Book of 9 February 2000, on environmental responsibility, COM (2000) 66 - not published in the *Journal Officiel.*
(14) Inserted in new Article L.160-1 of the Environmental Code.
(15) Austria, Wallonia, Greece, France, Finland, Ireland, Luxembourg, Slovenia and the United Kingdom.

By Patricia Savin, Savin Martinet Associés

Analysis of the French text incorporating the Directive[16]

Under the terms of this law, operators whose activities risk causing imminent damage[17] or have already caused damage to the environment above a certain level[18] will be obliged to prevent or repair such damage. This law establishes no-fault liability and at-fault liability[19]. This is not a new form of civil liability but a special new policy to be enforced by the Prefect. It will require the Prefect to impose the necessary preventive or remedial measures on operators in accordance with the law. Thus, the question of which of the activities (listed in Annex III of the Directive relative to no-fault liability for damage to soil, water and protected natural habitats) are to be included in the law will be determined by a decree adopted by the Conseil d'Etat.

The activities subject to this no-fault liability could include extraction and discharge performed in installations, structures and operations; the operation of installations classified under environmental protection regulations; the contained use of genetically modified micro-organisms; the deliberate release into the environment or placing on the market of GMOs; waste disposal operations, with the exception of the spreading of sewage sludge from urban waste water treatment plants; operations relating to cross-border transport of waste and to the manufacture, use, storage, processing, packaging, release into the environment and on-site transport of hazardous materials, pesticides and hazardous products; and the transport by land, sea or air of hazardous merchandise.

Furthermore, occupational activities other than those listed which have caused damage to protected species and natural habitats are the responsibility of the operator only in cases of actual fault or negligence. The law allows for the possibility of exemption from the costs of prevention and remediation relative to the risk of development, as laid down in Article 8.4 of the Directive[20], if the operator can prove it was not at fault or negligent. However, the law does not allow for exemption from costs related to compliance with licensing and operating regulations. The operator can recover the costs incurred, however, if it proves that the damage has an external cause (the acts of a third party or the result of compliance with a compulsory order issued by a public authority). If several operators have jointly caused the damage, the Prefect will divide the costs of the measures adopted among them all . The damage caused by diffuse pollution is not covered by the law unless causal links of liability can be proved.

A special force for prevention and remediation of damage has been established on the model of that applying to installations classified under environmental protection regulations and the installations, structures, work and operations concerned in water management. Operators to whom the law applies are required to adopt measures, under the supervision of the Prefecture, to prevent or repair all serious harm to the environment. The preventive measures must, *"in cases of imminent threat of damage,... prevent its occurrence or limit its effects"*[22], and the measures of remediation of damage to the soil must *"eliminate any risk of serious harm to human health"*[23].

(16) Law No. 2008-757 of 1 August 2008 relating to environmental responsibility and various mechanisms of adaptation to European Community law on the environment.
(17) By posing an imminent threat of damage which is sufficiently probable that it will occur in the near future.
(18) As defined in Articles L.161-1 and L.161-2.
(19) Thus an individual who suffers harm as the result of environmental damage or of the imminent threat of such damage cannot demand remediation on the basis of this law (Article L.162-2).
(20) New Article L.162-23 of the Environmental Code.
(21) New Article L.162-18 of the Environmental Code.
(22) New Article L.162-3 of the Environmental Code.
(23) New Articles L.162-8 and -9 of the Environmental Code.

4.1.5

The remediation measures for damage to bodies of water and to protected species and natural habitats are of three types. First, *"primary measures"* to restore protected bodies of water, species and natural habitats (including ecological services) which have been damaged to their original condition, while eliminating any serious risk to human health. Second, if they cannot be restored to their original condition, *"complementary remediation measures"* should be undertaken to help restore a level of resources or services comparable to those which would have been available if the site had been restored to the condition it was in at the time the damage was caused. Third, on the assumption that the primary and complementary measures have been implemented, non-financial *"compensatory remediation measures"* should be undertaken to compensate for interim losses.

The implementation of these three principles means that the operator, in cases of imminent threat of damage[24], must without delay and at its own expense take necessary preventive measures, and if the threat persists must inform the Prefect[25]. If actual damage occurs, it must inform the Prefect, and without delay and at its own expense take measures necessary to eliminate the causes of the damage[26]. To meet the goals for the compensation of environmental damage set by the law, the operator must propose reasonable repair options to the Prefect for approval and identify the most appropriate remediation measures.

In case of non-compliance by the operator with the official notification sent to it within the prescribed period of time, the Prefect may, under Article L.162-14-II of the Environmental Code, require the deposit of a sum of money for the implementation of the measures and may proceed at his or her own expense to implement them. In cases where preventive or remediation measures have been implemented by persons other than the operator (on the Prefect's authority, or by other persons in cases of emergency), the operator will be required to reimburse the costs to these persons[27].

The effective implementation of the measures which the Prefect can impose on the operator, under the special powers granted by the law, also relies on the establishment of penal provisions under which failure to comply with the official notification by the Prefect that the necessary preventive and remedial measures must be undertaken is punishable by six months' imprisonment and a fine of 75,000€[28].

(24) A decree will specify the conditions under which the existence of an imminent threat of damage is to be recognised.
(25) New Article L.162-3 of the Environmental Code.
(26) New Article L.162-4 of the Environmental Code.
(27) New Articles L.162-19 and -20 of the Environmental Code.
(28) New Article L.163-5 of the Environmental Code.

By Patricia Savin, Savin Martinet Associés

The Directive did not provide for a compulsory insurance scheme for operators, but noted its usefulness: this would guarantee payment of remediation costs in case of the operator's insolvency. The new law has also not included this provision.

Conclusion

The final wording of the law, adopted on 1 August 2008, leaves a number of important issues unresolved. Identifying the "initial condition" will give rise to arguments and problems. What criteria are to define it? Furthermore, what is meant by the "seriousness" of the damage? Article L.161-1 of the Environmental Code, which defines the range of application of the law, specifies that damage to the environment is caused by measurable alterations with a "seriously" negative effect on soil conditions, surface water quality or the conservation of protected species and natural habitats. Does this imply a lesser level of protection than the Directive, which does not invoke the concept of serious damage? The new Directive on the protection of the environment via criminal law provisions[29], which will soon be formally adopted by the Conseil d'Etat, might clarify the situation, particularly given that it lists all the activities which could be considered criminal offences: both companies and their employees are open to prosecution. Member States ought to enforce the laws, regulations and administrative provisions necessary for compliance 24 months at latest after the Directive becomes law, that is, on the twentieth day following its publication in the *Journal Officiel.*

Furthermore, the concept of "ecological services" which the law refers to may give rise to further debate. Article L.161-1 I, 4o of the Environmental Code stipulates that *"measurable deterioration of the environment which (...) affects ecological services, that is to say the functions provided by the soil, water, species and habitats listed in the 3rd [subsection of the Article] which are of benefit to one of these natural resources or to the public, excluding services provided to the public through developments implemented by the operator or owner"* constitutes environmental damage.

Likewise, the term "operator" calls for clarification. Article L.160-1 of the Environmental Code defines an operator as *"any person or entity, public or private, employed in performing or effectively controlling a for-profit or non-profit business activity".* The explanatory memorandum to the draft law states that "control" within the meaning of this Article does not include that of the shareholders, credit institutions, administrative controllers or trustees; it assigns the task of ensuring that this definition is implemented in accordance with the objectives of the Directive to the appropriate administrative authority, subject to judicial review.

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(29) http://register.consilium.europa.eu/pdf/fr/08/st03/st03639.fr08.pdf.

4.1.6

In the Maya Biosphere Reserve (MBR), encompassing more than two million hectares of rainforest in Guatemala's northern Petén province, a study by the Rainforest Alliance shows that forests managed according to Forest Stewardship Council (FSC) standards suffer less deforestation and fewer wildfires than non-FSC-certified land. These results are based on analysis of information from the U.S. and Guatemalan governments and from NGOs, including satellite images taken in the years 1986-2007.

Among the study's findings:

- From 2002 to 2007, the average annual deforestation rate for the entire reserve was 20 times higher than that of the FSC-certified concessions.
- Since 1998, the amount of forest area in the MBR burnt annually in wildfires has varied from seven to 20 percent, while the area burnt on FSC-certified concessions has steadily dropped from 6.3 percent in 1998 to 0.1 percent in 2007.
- FSC-certified forests in the reserve have even fared better than strictly protected land, demonstrating better conservation and resistance to illegal incursions than in the protected areas.

Background: the Maya Biosphere Reserve – history and context of environmental threats

The Maya Biosphere Reserve, created in 1990, is recognized by UNESCO as one of three biosphere reserves – the other two located in Belize and Mexico – forming one of the largest tropical forests north of the Amazon. The MBR encompasses more than two million hectares of rainforest, about 10 percent of Guatemala's national territory. About 70% of wood and non-wood products from the reserve are sold to the United States.

The reserve's forests are under frequent assault by illegal farmers, cattle ranchers and loggers. The resultant deforestation is greatest near the newer settlements where the inhabitants do not have a tradition of utilizing the natural forest[30].

While wildfires in the reserve do not directly cause deforestation, they are an indicator of human pressure and of an advancing agricultural frontier. These wildfires – generally creeping ground fires that cause dramatic changes in the composition of the forest and the mortality of mature trees[31] – are caused either intentionally or by neglect, and usually result from burning land to clear it for crops. The frequency, extent and damage caused by wildfires is related to the weather; in particular, the dryness associated with periodic El Niño climatic events results in more fires from controlled burning getting out of control.

The Guatemalan National Protected Areas Council (Consejo Nacional de Areas Protegidas or CONAP) administers the reserve and, at its inception, divided it into three zones, each with a different degree of resource management[32] :

- **Core protected area** (CPA) – Strictly protected land composed of five national parks, four biotopes and one cultural monument: 816,000 ha, 40 percent of the reserve.
- **Multiple use zone** (MUZ) – Designated for managed, sustainable low-impact agriculture and forestry: 789,100 ha, 38 percent of the reserve.
- **Buffer zone** (BZ) – Agriculture and land ownership are allowed in this 15-kilometer wide strip at the southern limits of the MBR. So as to alleviate their impacts on the reserve, communities within this area receive environmental education and training in sustainable resource management: 462,500 ha, 22 percent of the reserve.

(30) Ramos, V.H., Burgués, I., Fleco, L.C., Castellanos, B., Albacete, C., Paiz, G., *et al,* 2007. Análisis económico y ambiental de carreteras propuestas dentro de la Reserva de la Biofera Maya. Wildlife Conservation Society

(31) Pinelo, G., 2001. Efecto de un incendio forestal rastrero sobre la vegetación de un bosque natural latifoliado en San Francisco, Petén, Guatemala. Master's thesis, University of San Carlos, Guatemala.

(32) Consejo Nacional de Areas Protegidas (CONAP), 2001. Plan Maestro de la Reserva de la Biofera Maya 2001-2006.

By David Hughell and Rebecca Butterfield, Rainforest Alliance

Dividing the land in this manner sparked resistance from environmental groups who had lobbied for complete protection for the area and opposed allowing agriculture and forestry within its boundaries. In response, CONAP required that new forest concessions within the multiple-use zone become Forest Stewardship Council (FSC) certified within three years of the initial concession grant.

The Rainforest Alliance, other NGOs and donors

Since its inception, the MBR has received considerable donor support. The United States Agency for International Development (USAID) has been one of the largest donors in the region, supporting technical assistance in natural forest management and strengthening CONAP and the community concessions. Donors have supported the Petén Association of Forest Communities (Asociación de Comunidades Forestales del Petén – ACOFOP), which assists communities with respect to organizationnal and managerial challenges and represents them within debates and fora relating to policy issues[33].

The Community Vigilance Project, working in collaboration with the Rainforest Alliance and the Wildlife Conservation Society (WCS), supports community patrols that suppress fires and control concession boundaries against squatters, thereby helping communities meet FSC requirements.

Since 2002, the Rainforest Alliance's Training, Extension, Enterprises and Sourcing (TREES) program has improved the economic viability of the concessions. TREES also supports the Petén community forestry business FORESCOM, S.A.

FSC-certified concessions

Since 1998, the Rainforest Alliance's SmartWood program has certified 14 forest management concessions within the multiple-use zone according to FSC standards: 12 concessions are community managed while two are industry managed. The FSC certificates of three of the concessions have been terminated or suspended due to internal organizational difficulties, illegal land acquisitions ("invasions") and / or economic difficulties.

The remaining 11 FSC-certified concessions encompass 479,500 ha, which represent 60 percent of the multiple-use zone and 23 percent of the reserve's total area. The three non-FSC certified concessions consist of an area of 48,500 ha, or 6 percent of the multiple-use zone. The remaining 33 percent of the multiple-use zone is not allocated to any concession.

Methods

CONAP's Center for Monitoring and Evaluation (CEMEC) used geographic information systems (GIS) to process LANDSAT satellite imagery on forest cover from 1986 to the present (figure 18). We used these spatial data layers to calculate the average percent annual deforestation rate by dividing the loss in forest cover by the total forest cover in 1986 and by the number of years in the period studied. This was done for each of the three management classes and for the FSC/RA-certified concessions and the (non-certified) remainder of the multiple-use zone (table 13), in order to assess the relationships among management classes, certification and deforestation.

(33) Nittler, J. and Tschinkel, H., 2005. Community Forest Management in the Mayan Biophere Reserve of Guatemala – Protection Through Profits.

4.1.6

Impact of FSC certification on deforestation

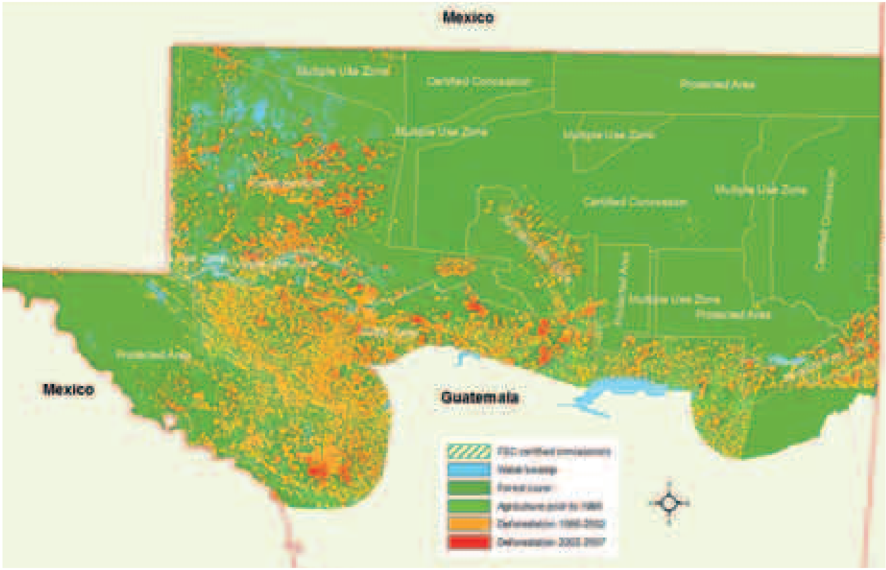

Figure 18 : Forest cover and deforestation in the MBR from 1986 to 2007 in relation to FSC-certified forest concessions.

For the years 2002 to 2007, we determined that the average annual deforestation rate for the entire MBR was 0.88 percent, which is over twenty times higher than the deforestation rate for the FSC-certified concessions (0.04 percent) (table 13). Similarly, the average annual deforestation rate for the core protected areas (0.79 percent) was nearly twenty times higher than the rate for the FSC-certified concessions.

The buffer zone is under pressure for conversion of forests to agricultural use and, as expected, had a high deforestation rate (2.48 percent from 2002 to 2005 in table 13). However, one would not expect to see the high recent deforestation rate of the core protected area (0.79 percent), in which all forestry or agriculture is illegal. The deforestation rate for the non-certified areas of the multiple-use zone was 0.86 percent – possibly indicating what would be at risk for the whole multiple-use zone if it were not FSC-certified.

By David Hughell and Rebecca Butterfield, Rainforest Alliance

TABLE 13: ANNUAL DEFORESTATION RATE AVERAGED OVER THE ENTIRE STUDY PERIOD COMPARED TO THE LAST THREE YEARS

Land class	1986 to 2005	2002 to 2005
Core protected areas	0.36 %	0.87 %
FSC/RA certified concessions in multiple use zone	0.03 %	0.06 %
Remainder of multiple use zone	0.40 %	0.92 %
Buffer zone	1.98 %	2.48 %
Entire MBR	0.58 %	0.98 %

If the current deforestation rate continues, by 2050 the reserve will have lost 38 percent of the forest cover that it had in 1986, while the FSC-certified lands would remain relatively intact with only a three percent loss (table 14). The 38 percent figure can be broken down as follows for the land-use zones: 16 percent loss will occur in the buffer zone, 16 percent in the core protected areas, seven percent in the non-certified multiple-use zone and one percent in the FSC-certified area of the multiple-use zone.

TABLE 14: PROJECTED AREA UNDER FOREST COVER AND PERCENTAGE (OF 1986 FOREST COVER) IN 2025 AND 2050 ASSUMING AVERAGE ANNUAL DEFORESTATION RATES BETWEEN 2002-2005 BY MANAGEMENT CLASS IN MBR

	1986	Deforestation	2005		2025		2050	
Land-use zone	Ha	rate (%)	Ha	% forest remaining	Ha	% forest remaining	Ha	% forest remaining
Core protected area	795,326	0.9 %	741,227	93 %	612,814	77 %	480,105	60 %
FSC-certified concession	484,798	0.1 %	482,203	99 %	476,421	98 %	469,280	97 %
Multiple-use zone	304,286	0.9 %	281,324	92 %	229,505	75 %	176,663	58 %
Buffer zone	363,747	2.5 %	227,128	62 %	114,419	31 %	43,445	12 %
MBR	1,948,157	1.0 %	1,731,883	89 %	1,433,159	74 %	1,169,494	60 %

4.1.6

Impact of FSC certification on the incidence of wildfires

In nearly all the years for which they were documented (2007 excepted), wildfires burned nearly 20 percent of the MBR (Table 15). The years 1998, 2003 and 2005 showed a decreasing incidence of wildfires in all land-use zones – with the important exception of the core protected areas, where wildfires *increased* from almost 24 percent of the land base in 1998 to nearly 30 percent in 2005. The FSC-certified concessions have had consistently fewer wildfires than the remainder of the multiple-use area and the other land-use zones. (This contrast is evident in figure 19). The repeated and escalating nature of those fires, which points to an increase of human presence and settlement within the protected areas, substantiates the spike in deforestation found within the core area. In contrast, the decline in wildfires within the FSC-certified forest concessions from 6.3 percent of the area in 1998 to 0.1 percent in 2007 underscores the effectiveness of the community wildfire vigilance and community awareness programs as well as FSC requirements for protection plans.

TABLE 15: PERCENTAGE OF AREA BURNED IN EACH LAND USE ZONE BY YEAR

Land-use zone	1998	2003	2005	2007
Core protected areas	23.6 %	26.0 %	29.6 %	10.4 %
FSC/RA certified concessions in Multiple-use zone	6.3 %	1.8 %	0.1 %	0.1 %
Remainder of multiple-use zone	21.9 %	21.3 %	12.9 %	5.0 %
Buffer zone	23.9 %	23.5 %	19.6 %	10.3 %
Overall MBR (%)	19.5 %	19.1 %	18.0 %	7.2 %
Overall MBR (ha)	404,632	398,280	375,149	149,424

Conclusion

This study found significantly less deforestation and fewer wildfires within the FSC-certified concessions than in the remainder of the multiple-use zone and the overall reserve. A more detailed analysis might be able to further research factors such as settlement patterns, livelihood strategies, road access, and vegetation type within the various land-use zones.

The decision to grant forest concessions within the MBR was contentious in 1990, but we have seen that it was strategically astute for the long-term protection of the forest. If current rates of deforestation

By David Hughell and Rebecca Butterfield, Rainforest Alliance

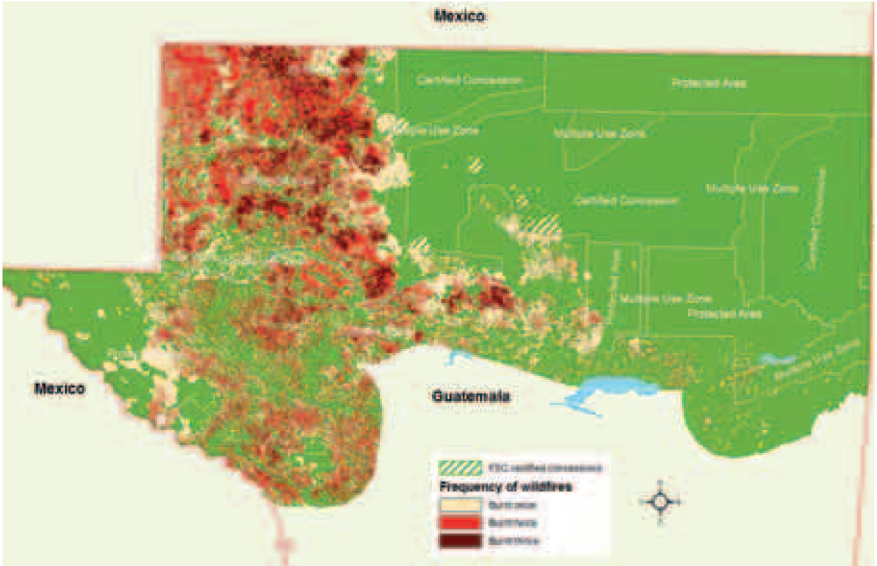

Figure 19 : Frequency of wildfires for 2003, 2005 and 2007 fire seasons in the MBR

continue, by 2050 the reserve will have lost 38 percent of the forest cover that it had in 1986. Most of that loss should be within the western core protected areas and the buffer zone.

The success of the concessions in conserving their forests is likely due to FSC's sustainable management and skill training as well as to access to new markets that provide more income to concessionaires. Other factors must include continued donor support and the work of public and private organizations to promote environmental awareness, community vigilance programs and sustainable economic activities.

FSC certification has played a pivotal role in conserving Petén's forests – and will have an increasingly important role in the future.

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4.1.7

The Seine estuary

The Seine estuary extends over 160 km of the English Channel coastline, from the eastern end of the Baie de Seine up as far as Poses, where the tidal waters are blocked by a dam. It includes the main course of the river itself, its banks and the surrounding wetlands. Administratively, the estuary lies at the interface of two regions (Haute-Normandie and Basse-Normandie) and three departments (Eure, Seine-Maritime and Calvados). The Seine watershed as a whole covers 79,000 km2, and includes 16 million inhabitants, 50% of the river traffic of France, 40% of its economic activity and 30% of its agricultural activity.

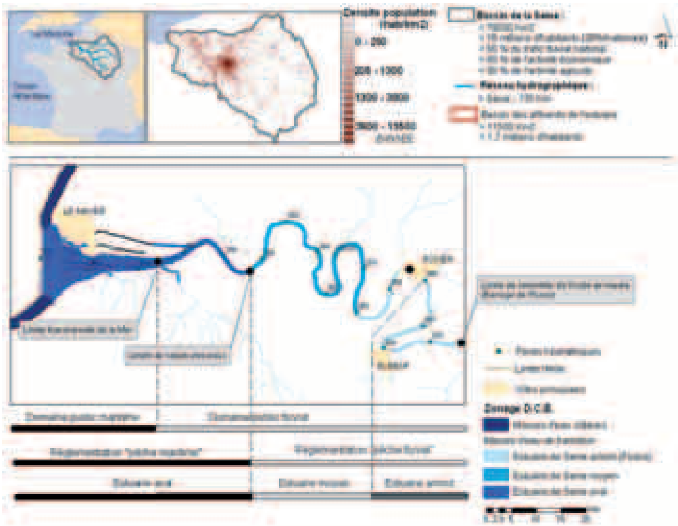

Figure 20 : Geographical location of the Seine estuary

The average rate of flow of the Seine, at 430 $m^3.s^{-1}$, is low relative to other major estuaries in France (the Loire and Gironde). Flood stage can reach a volume of 2200 $m^3.s^{-1}$ and low flow levels less than 100 $m^3.s^{-1}$. The combination of mega-tidal conditions (tides of > 8 m at Honfleur and > 4 m at Rouen) with the volume of river flow leads to the formation of a "mud trap", that is, a zone of maximum turbidity which builds up in the mouth of the river. This traps particles and acts as a physico-chemical regulator for the natural suspended sediment and contaminants, including metals, brought down by the river. In addition to the inputs of fine suspended sediment from up-river, a significant amount of transit sediment is also carried from the Baie de Seine towards the estuary, naturally filling it up. However, part of the sediment in the estuary is dredged by the Port Authority of Rouen and Le Havre.

4.1.7 GLOBAL MANAGEMENT OF THE SEINE ESTUARY: FROM THE DEGRADATION TO THE REHABILITATION OF ITS ECOLOGICAL FUNCTIONS

By Jean-Claude Dauvin, Stephanie Moussard and Jean-Paul Ducrotoy, GIP Seine-Aval

Industrial zone, port of Rouen

The development of the Seine estuary, especially for navigation purposes, began very early, in the mid-nineteenth century, and continues today. Its chief effect is the extreme fragmentation of ecological units and the drastic reduction of ecological habitats, especially in the intertidal zones (between high and low tide marks) at the downstream end, with a loss of over 100 km² between 1850 and the present. Although the ecological functioning of the estuary is seriously threatened, it still constitutes a major reservoir of biodiversity. This is a favourable environment for the young of many fish species[34], and its ornithological richness makes it a major asset for our natural heritage. With the exception of navigation and related industrialisation, other economic and social activities have suffered from the estuary's development. Beginning in the second half of the twentieth century, the local population has gradually turned away from the Seine, as indicated by the diminution of commercial and recreational fishing, the closing of shipyards and the inaccessibility of the towpaths.

In parallel with the development of the estuary, the physico-chemical conditions of the environment have been deteriorating inexorably for over a century, resulting by the late 1980s in a highly contaminated environment, with levels of contamination among the highest in the world for metals (cadmium, silver and mercury), polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs), as well as serious oxygen deficiency (hypoxia) in the river downstream of the Paris and Rouen conurbations. Regulation, improvements in industrial production methods and the use of water purification techniques have since produced a marked improvement with respect to some "classic" pollutants including metals and phosphorus.

Today, the chemical hazards associated with new products such as medicines or detergents, linked to the presence of bacteria resistant to antibiotics in the water, are also troubling. These substances are a source of concern, but they are still too recent for their evolution and impact to be known fully.

Though there are still some problems, the overall water quality seems to be improving and remains under close surveillance given the environmental and health risks and the importance of the estuary for biodiversity.

The gradual introduction of a governing authority for the Seine estuary (Lozachmeur and Dauvin, 2007)[35]

In the late 1990s, in the course of the construction of Port 2000, the extension of the port of Le Havre, the need became clear for a comprehensive approach to the Seine estuary, with an overall strategy and consultative bodies to oversee it. The government therefore decided to launch the **"Plan for the renovation of the Seine estuary"** and to include it in the in December 1998. Among the priority goals of the CPER are:

(34) 60% of commercially usable fish spend some or all of their lives in the estuary.

(35) Lozachmeur, O., Dauvin, J.C., 2007. "Réflexions sur la restauration et la gouvernance de l'estuaire de la Seine dans une perspective de gestion intégrée des zones côtières. Rapport au GIP Seine-Aval".

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- To *"open the region to international trade through the development of the ports, in particular that of Le Havre (Port 2000) and the organisation of their logistical and industrial hinterland in the valley of the Seine"*;
- To *"restore an extremely degraded environment"* by *"establishing a comprehensive management plan for the Seine estuary"* (PGGES - "Plan de gestion global de l'estuaire de la Seine").

The goal of the PGGES was to promote the economic diversification (port and logistical development) of the estuary, focusing on industry, tourism and fishing, to maintain and restore its natural functioning, and to support and structure its management. With this in mind, in 2001 the state and the Haute-Normandie region jointly established, via inter-ministerial letter, a legally informal governing mechanism structured around a Conseil.
The Conseil is an executive body bringing together the most senior representatives of local government, the state and the ports on the estuary. Its remit is to define and implement the PGGES, and to ensure the internal consistency of all the policies applicable to this area. Since 2007, it has also been responsible for monitoring and evaluation of the Directive Territoriale d'Aménagement (DTA - Regional Development Directive). It is assisted by a Conseil scientifique et technique whose opinions and proposals add significant scientific value for decision-makers, who can draw on them when useful for the topics discussed. A Monitoring Committee collects and passes on information as needed.

The construction of Port 2000 (and the implementation of related pro-environment measures), proposed in 1999 by a committee of scientific experts drawing on the results of the Seine-Aval Research Programme, has meant that the majority of the initiatives planned have been concentrated on the PGGES, thus essentially limiting their geographical range to the seaward section of the estuary.

Supporting operations for Port 2000: cutting a new upstream meander, 2005

Supporting operations for Port 2000: building a breakwater to promote the formation of a mud bank

The construction of Port 2000 was a chance to highlight the importance of striking a balance between the goals of economic development and the protection of aquatic and natural environments, by way of the appropriate, integrated management of the estuary. The new port facilities included structures built in the sea (north trench) and on land (wetland) which threatened the long-term conservation of the mudflats to the north. The supporting operations intended to reduce the hydro-sedimentary impact and sustain the vast inter-tidal mudflats to the north were decided on after a solution was modelled. They consisted mainly of digging an upstream channel, dredging over 3.5 million tonnes at the downstream end to enable traffic to keep circulating in the north trench, constructing a bird stopover habitat on a dune and another on an islet in the south trench.

The estuary Conseil has become primarily a forum for debate and discussion; however, it has issued some decisions with respect to actions, research studies and guidelines in co-ordination with the PGGES. The lack of human and financial resources allocated to it has affected its capacity to make decisions, to inform and to implement actions. Today, though the parties concerned have come to agree on some aspects of the diagnosis of the zone's problems, mainly on the subject of the environment, they have not yet managed to organise themselves to start up a really systematic plan for overall management of the estuary in the long term.

Nonetheless, many development projects are already in the works. These concern developments in the port of Rouen (deepening of the access channel), Le Havre (improvement of river transport via the extension of the Grand Canal to the Tancarville Canal) and Paris (increasing traffic and maximum size of shipping upstream of Rouen). A third bridge across the Seine further downstream is deemed necessary to increase rail transport frequency and improve services to Port 2000. Permission to extract aggregates from the Baie de Seine has been requested, to meet the growing needs of public works and the scarcity of resources.
All these projects should be managed in future through dialogue among all users of the Seine estuary.

A conscious commitment to restoring the territorial, socio-economic and ecological integrity of the Seine estuary

The parties concerned with the estuary who represent supra-regional entities[36] have initiated discussions about its environmental rehabilitation, each in their own domain but in joint consultation. The national government, at the urging of the estuary Conseil, has co-ordinated a study of the future environmental conditions of the estuary, including an estimate of the financial cost of various rehabilitation scenarios. This research has helped to start a process of consultation among the parties concerned and to bring the discussions down to earth by making projections of future conditions (up to 2025). Participants have recognised the need to get beyond local interests and think about the estuary as a whole, and have acknowledged the dependence of local stakeholders on external factors which will have a decisive effect on the estuary's long-term functioning. Among the key take-home lessons of this projection report are:

- The environmental risks if the approach to managing the area which prevailed until the early 2000s is continued;
- The need to establish a form of governance better suited to the overall management of the area, with the capacity to co-ordinate the rehabilitation of the environment.

Growing awareness, accelerated by the introduction of the fourth phase of the Seine-Aval programme, has also helped to incorporate socio-cultural issues into the environmental rehabilitation of the estuary. However, the inclusion of economic questions, dominating ones for the Seine estuary, in the socio-ecological discussions is still in its infancy (Ducrotoy and Dauvin, 2008)[37].

(36) The General and Regional Conseils, the Water Board, GIP Seine-Aval, the national government and the Port Authority, among others.
(37) Ducrotoy, J.P., Dauvin, J.C., 2008. "Spatio-temporal scales in estuarine conservation and restoration". *Marine Pollution Bulletin* 57, 208-218.

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The importance of rehabilitation which would serve the interests of all the various users, in response to shared expectations and with their consent, has gradually surfaced in both global research studies and local initiatives.
We might note some recent terminological changes. When speaking of the Seine estuary and "environmental rehabilitation", people are beginning to use the term "reconquête", to emphasise the recapture and reclaiming of the estuary by its users. This term is to be found in prospective research reports[38], such as the report on the "Development of the Seine-Aval" (Seine Maritime Conseil Général, in process) and the technical reports currently being prepared by GIP Seine-Aval.

These research reports and projects are directed at rehabilitating and reclaiming the estuary via the combined goals of the protection of property and persons, reclaiming of the river and riverside by users, balancing of economic, social and environmental use of the area, environmental rehabilitation, consciousness-raising and educating the general public.
The fit of these initiatives with the PGGES and DTA has still to be improved. This is to be established primarily via dialogue within the decision-making bodies of the various agencies concerned and the estuary Conseil and its Conseil scientifique et technique. As of 2008, a comprehensive structure for joint action has yet to be clearly delineated.

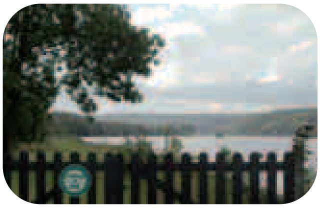
GIP Seine-Aval, one of the participants in the overall management of the Seine estuary

At the interface between research and management, the Groupement d'intérêt Public Seine-Aval (GIP Seine-Aval Public Interest Group), founded in 2003, has eleven members: the national government, the Seine-Normandy Water Board, five local authorities, two industrial organisations and the two Port Authorities of Rouen and Le Havre.
Its two chief tasks are to oversee a programme of applied interdisciplinary research on the Seine estuary and to communicate the operative results of this research to its members and their partners.
The research programme is in its fourth phase (2007-2012), and focuses on three questions:

1. Systematic observation: how is the estuary doing and how will it evolve?
2. Environmental rehabilitation and reclamation by the users: what kind of estuary do we want?
3. Health and environmental risks: what risks are the people of the estuary exposed to?

The role of GIP Seine-Aval in the environmental rehabilitation and reclamation of the estuary by its users

GIP Seine-Aval contributes to the environmental component of the overall management of the estuary by summarising and communicating knowledge drawn from the research and reporting programme it conducts independently. It contributes expertise on the socio-ecological functioning of the estuary to help its partners implement their own projects: compensatory measures, assistance



Inaccessible towpath

(38) Préfecture de Région Haute-Normandie, 2004. "Restauration de l'estuaire à l'horizon 2025"; Préfecture de Région Haute-Normandie, 2008. "Appui à l'élaboration d'une stratégie de gestion: documentation et chiffrage des scénarios prospectifs sur l'estuaire de la Seine".

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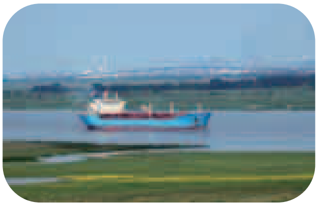
with projects in the ports, environmental studies, development of indicators and measurement networks, initiatives and monitoring in connection with industrial waste discharge, and inter-estuary projects.

To accomplish this, as well as monitoring and assistance with research reports and projects undertaken as part of the Seine-Aval Programme[39], the Group is seeking to build up its empirical knowledge of the functioning of the estuary system. It is now setting up sites for ecological monitoring and experimentation so as to gain an understanding of the workings of some local micro-systems and to take these into account in implementing a rehabilitation and management programme on a much wider scale. The Group is also planning to make its activities better known and concentrate them around sites at which data and results from several disciplines could be brought together.
Lastly, GIP Seine-Aval is developing a project around a shared scientific goal for the medium term, asking *"what kind of estuary do we want".* This discussion is to focus on:

- Definition of the economic, environmental and social features of the estuary;
- Understanding of the functional relationships between the environment, the area and the populations (plant, animal and human) which inhabit it, and projecting them into the future, taking into account global changes, including climate change;
- Understanding and knowledge of the expectations and plans of managers working in the area;
- The relations between these various components of the estuary system and the principal levers for action.



Rehabilitated creek, serving as a fish hatching ground and refuge

This research project will be used to construct scenarios for the future of the estuary, balancing the preservation of biodiversity against economic and social development over the long term. The Group's partners will be able to take up this discussion and adopt those of its features which will help them implement a truly comprehensive estuary management system.

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http://seine-aval.crihan.fr/webGIPSA/

(39) A number of scientific research projects focusing on the ecological, social and economic features of the Seine estuary are studying functional relationships between aquatic habitats and their use by certain species (benthos, fish guilds), estuary landscapes and the expectations and behaviour of their users, and the impact of navigation on the riverbanks and the ecological roles they fulfil.

4.1.8

The South African wine industry and the conservation sector, namely the Botanical Society of South Africa and The Green Trust - a WWF-Nedbank partnership, have come together in a pioneering initiative to ensure that "eco-friendly" wine farming is taken on board and made a priority within the South African wine industry. The resulting Biodiversity and Wine Initiative focuses not only on preserving critical areas of natural habitat remaining in the Western Cape, but also on incorporating best biodiversity management practices into the production schemes of the South African wine industry.

South Africa is the world's ninth largest producer of wine, with approximately 90% of national wine production occurring within the Cape Floral Kingdom (CFK), the smallest yet richest plant kingdom on earth. The CFK is globally recognised as a biodiversity "hotspot" and some of its gems hold World Heritage Site status, as a home to 9 700 plant species (including numerous endemics), tens of thousands of animal species. Add to this an outstanding variety of climatic and soil properties responsible for the region's outstanding wine!

Yet, due to the rapid loss of natural habitat through urban development, agriculture, invading alien vegetation and frequent fires, only 8% of the original renosterveld and lowland fynbos ecosystems remain in the Western Cape. Many of their species are so specialised that they are commonly confined to one particular farm or patch of vegetation - and hence found nowhere else in the world!

An initial study, commissioned by Conservation International and The Botanical Society of South Africa, investigated the role played by ongoing vineyard expansion in the biodiversity loss within the Western Cape Province: as it lead to the assessment of the wine industry's spatial footprint, key players from the wine, conservation and agricultural sectors decided to work together so as to determine how best to address the following issues:

- Prevent further loss of habitat in critical sites;
- Increase the total area of natural habitat set aside as contractual protected areas;
- Promote changes in farming practices so that to enhance the suitability of vineyards as habitat for biodiversity, and reduce their negative impacts on surrounding natural habitat;
- Create marketing opportunities for the wine industry by positioning the biodiversity of the CFK, as well as the industry's proactive stance on biodiversity, as a unique selling point to differentiate South African wine brands and establish a distinctive platform for the official marketing arm of the wine industry, namely Wines of South Africa (WOSA) to develop the overall South African wine category – known as Brand South Africa to promote South Africa both as a wine tourism destination and unique wine product.

The Biodiversity and Wine Initiative – A multi-stakeholder project

Launched in 2004, the BWI was initially funded by the Critical Ecosystems Partnership Fund and Conservation International. It is now co-funded by the South African Wine Industry (namely Wines of South Africa – the official marketing body for the industry, Winetech – a research and technology transfer organisation, SA Wine Council – overarching body of the wine industry) and the conservation sector (The Botanical Society of South Africa and a WWF-Nedbank Partnership, The Green Trust). These BWI project officers are employed by the conservation sector (The Botanical Society of South Africa) to maintain third party independence and

By Inge Kotze, Biodiversity Wine Initiative

credibility, but housed within a Wine Industry structure (SA Wine Council) so as to facilitate daily operational interaction and networking.

The BWI operates on two levels of producer engagement: **BWI members (entry level)** and **champions (exemplary level).** Membership status requires that local producers make a commitment to conserve remaining priority natural habitats on their farms and to implement the programme's comprehensive biodiversity guidelines. Championship status is thus conferred only to producers who have made outstanding progress. To that end, they need to:

- dedicate at least 10% of the total farm size to natural habitat under a conservation easement;
- develop a conservation management plan;
- And demonstrate progress in its implementing.

Linking the Integrated Production of Wine with the BWI

Integrated Production of Wine (IPW) is an industry-wide technical system of sustainable wine production scheme. One of the most important principles of IPW is that production should proceed in harmony with nature. The scheme has been in existence since 1998 and is published under the Liquor Products Act (Act No. 60 of 1989). It consists of guidelines and recommendations of what should be done, as well as minimum standards that need to be satisfied.

The IPW guidelines for farms consist of 15 chapters which address all cultivation aspects such as correct selection of cultivars, vineyard layout, irrigation, Integrated Pest Management, pruning, etc. Previously, the content of chapter 2 entitled *"Conservation and improvement of the farm and vineyard environment"*, did not adequately address biodiversity issues, such as threatened ecosystems (renosterveld or lowland fynbos) and the need to remove exotic species from natural habitats (a major source of threat for biodiversity). The BWI developed a revised version of Chapter 2 – now more commonly referred to as the *"Biodiversity Guidelines"*, which it strives to promote, notably by assisting producers in their implementation. All producers are then required to evaluate their farms for the yearly harvest.

Progress to date

Since its inception in 2004, the BWI has made excellent progress with industry uptake and commitment surpassing all expectations. To date, **115 of the Cape's wine producers** have joined the Initiative and the area conserved collectively represents just **over 70% of the 100 000ha vineyard footprint in the Cape Winelands** (70 412 ha as of April 2008). For every 2ha of planted vines, the Cape Winelands now have a further 1.5ha under conservation management – a phenomenal achievement in just three years!

The BWI has used various business strategies to position the South African Winelands' unique biodiversity as a competitive advantage within a globally oversubscribed wine market, providing participating producers with further incentives to conserve their natural areas and farm in an environmentally sensitive manner. By engaging with the retail sector and by raising consumers' awareness, the project drives a demand for eco-friendly products within new niche markets. Participating producers can thus use their conservation efforts and achievements so as to differentiate their products. In addition, incorporating biodiversity into South African Wine Tourism is being sought actively: it consists in the development of biodiversity routes which promote the conservation and wine history of each producer,. The world's first Biodiversity Wine Route – the Green Mountain Eco-route in the Grabouw–Elgin region – was also established under the auspices of this project in 2005. Both wine enthusiasts and nature-lovers may now explore and enjoy the natural and cultural heritage of the Cape Winelands through various activities ranging from vineyard hiking trails, guided tours, biodiversity information centres, bird hides, and of course wine testing.

BWI Member case studies

BWI champions are flagships estates in terms of their conservation commitments. Besides securing the minimum of 10% of their property under formal stewardship agreements, these farms are required to develop rigorous environmental management plans and to dedicate a person to that end on a full-time basis. Activities include the systematic clearing of alien invasive plant species, restoring wetland and riverine habitats, controlling problem animals in an environmentally friendly way, undertaking detailed plant surveys, implementing a sound fire management plan, building adequate solid waste facilities, and recycling.

Vergelegen Wine Estate leads the way with South Africa's biggest private alien vegetation clearing project

Vergelegen wine estate, internationally renowned for its magnificent vintages, is now garnering worldwide interest in its groundbreaking conservation programme. Vergelegen is undertaking South Africa's biggest private exotic vegetation clearing project - a R14 million, 10 year program to restore 2000 hectares of fynbos by 2014 on the 300-year-old wine farm. To that end, eight million densely packed invasive trees have already been cleared from 1000 hectares. The full extent of the threat posed by exotic invasive species was realised at Vergelegen after a major fire in 1997, when farm managers realised that the alien vegetation would now more than double in population size, hence seriously setting back all of the previous environmental work undertaken. Vergelegen decided to fight back with a comprehensive ten-year environmental plan headed up by an independent conservationist who is highly experienced in combating alien vegetation. He has helped train a team of 40 formerly unemployed people from local communities: they face a back-breaking task - clearing a five hectare area four years ago entailed taking out 65 tons of wet material, with enough vegetation left for a block burn. The team must follow meticulous safety guidelines that have ensured no injury in four years of work.

Since alien vegetation uses 50 to 800 times more water than the natural vegetation, reducing it has already boosted water flow: wetland areas are re-emerging and larger quantities of cleaner water are flowing from the farm to neighbouring communities.

For instance, a wetland area that was virtually "dead" is now fed by three streams that a local resident says are running for the first time in 50 years. In the first year of control, 22 indigenous plant species were recorded and this number has now reached 35. In addition, the number of bird species has soared from 80 to 109 while the farm also harbours numerous mammal species, leopard, caracal, antelopes, among many others.

Vergelegen has also set up a Centre of Learning Excellence with six Western Cape tertiary institutions, as well as overseas universities such as Bristol and Marburg. Besides, several students - from undergraduate to post-doctoral levels - are actively conducting research projects. One of them, run in conjunction with the City of Cape Town, is a social study on the "bontebok": once viewed as the rarest ante-

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lope in the world, its total population has grown from only 18 in the 1930s to around 2000 nowadays.

While findings from all research programs will be shared with farmers and other stakeholders, Vergelegen is also planning an outreach programme to help educate young learners about their environmental and cultural heritage.

Vergelegen wine maker André van Rensburg is adamant that the *"biodiversity move"* is improving yields and boosting the already formidable wine quality. *"You can only maintain virus-free vineyards and sustainable agriculture if you reduce the intensity of pesticides and herbicides. We have to restore nature, bring back species and ensure this farm is in a better condition than when we received it", he says. "Biodiversity complements the move to more natural growing of wine, allowing a truer reflection of the characteristics of individual vineyards and acknowledging the market's call for more products grown in harmony with nature."*

In other words, job creation, worker training, scientific research, learner education and ecological wine production form part of the ambitious plan being rolled out by farm owner Anglo American.

Future focus of BWI

The BWI will continue to raise awareness and support for conservation within the Winelands, by seeking the growth of the membership base and spearheading a process of continual improvement with existing members through audits on a biennial basis.

A primary conservation objective is to set aside at least 100,000ha as conservation areas by 2010. This will demonstrate the industry's significant commitment to their natural heritage, which would then be equivalent to the spatial footprint of vineyards in the Western Cape. In addition, the BWI will continue to pursue:

- The existing marketing strategy to promote the support and sales of environmentally friendly wine through the launch of a **BWI marketing label**;
- The diversification of the wine tourism portfolio in all regions of the Western Cape, by establishing further **biodiversity wine routes,** such as the West Coast's "Wine and wildflowers" and the southern coast's "Wine and Whales route" in the Overberg - Agulhas region, thus providing new employment opportunities for shared economic growth.

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Ecosystem accounting is an attempt to answer some basic questions relative to the sustainability of the interactions between the economy and the natural world.

- Do the functions performed by renewable natural capital (ecosystems), and the services it provides to the economy and society as a whole, persist over time, or do they deteriorate due to the combined impact of over-use and climate change?
- Is the cost of the maintenance and rehabilitation of natural capital covered by the prices charged for goods and services?
- Do the prices charged for imported products cover the full cost of the maintenance and rehabilitation of ecosystems in their countries of origin?
- Does the total of the means households (individually and collectively) need to survive, consisting of (a) goods and services provided in the economy and (b) ecosystem services used free of charge, really increase over time?

An expansion of ecosystem accounting is planned for the revisions under way in the UN's system of Integrated Environmental and Economic Accounting (SEEA, 2003)[40]. In fact, environmental accounting is already quite well integrated into the System of National Accounts (SNA), and covers mainly matters related to the pressures of production and consumption (use of natural resources, pollution emissions). Ecosystem accounting is designed to give a bigger picture, by measuring the impact of these pressures on the functioning of the ecosystems themselves, as well as the effects on that functioning of the services they provide to the economy and human well-being in general.

An accounting framework for ecosystems

This accounting framework is based on a standard double entry bookkeeping system. However, for ecological systems some additional features have to be taken into account. While the value of stock market holdings and cash can be added and subtracted to determine profit or loss, the various components of the ecosystem are expressed in different units and interact in non-linear ways. For example, the loss of organic matter in a lake may signal a malfunction, but so may an excessive increase. In general, ecosystems possess an initial equilibrium which they lose as a result of excessive pressure, only to recover it later on but generally in an impoverished form. The transition from one of these states to the next is not continuous but occurs in fits and starts, at moments when the ecosystem's resilience is lowered and a "flip" produces an "ecological surprise". This is usually an unpleasant surprise (the collapse of animal populations at the top of the food chain, loss of primary productivity), with far more serious consequences than any resulting from damage in the period preceding the flip. In practical terms, this means that if ecosystems are used properly, unstable situations can be prevented. In accounting terms, it means that a business's profitability will not be based on a simple computation but on an ecological rating (similar to the financial rating of companies listed on the stock market), combining its financial accounts, its physical accounts and an assessment of its health.

(40) UN, EC, IMF, WB, OECD, 2003. "Integrated Environmental and Economic Accounting (SEEA, 2003)", UN Statistical Division, New York. http://unstats.un.org/UNSD/envAccounting/seea2003.pdf.

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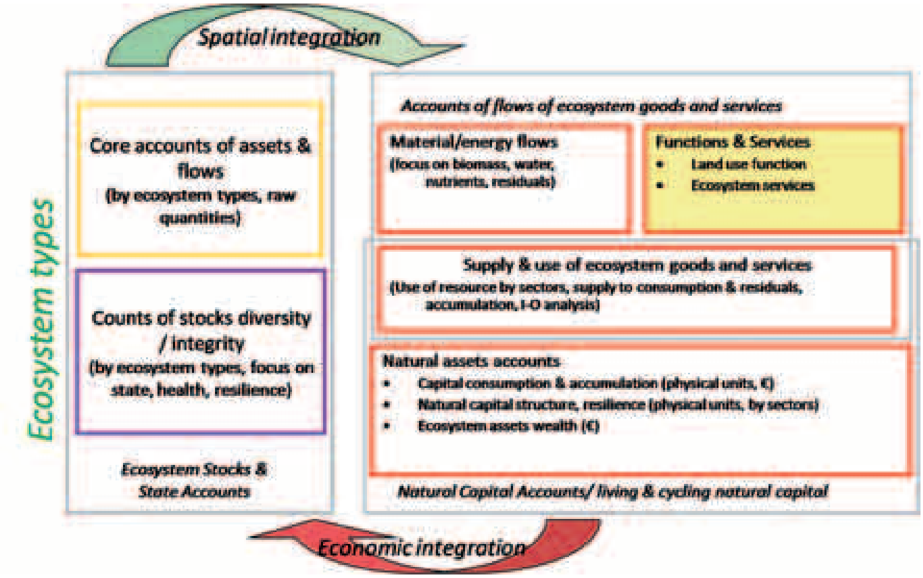

A general framework for ecosystem accounting

The chief assets included in the calculation of the rating are land areas, rivers, the soil, the sea, the air and their component parts (water, biomass, carbon, nitrogen, phosphorus, animal and plant species). Ecosystem health is assessed via the analysis of a defined set of symptoms (Ecosystem Distress Syndrome[41]): structure (combinations of species and their interactions), resilience (ability to recover after a shock), vigour, productivity, dependence on external inputs (fertiliser, irrigation, energy, subsidies) and ability to maintain healthy populations. These symptoms characterise ecosystem response to a multitude of pressures (physical restructuring by infrastructure projects, over-use, pollution, introduction of exotic species). Physical ecosystem accounting will combine an accounting of stocks and of health[42]. It will form the basis for calculating the additional maintenance and rehabilitation costs which may be needed to preserve ecosystems' capacity to provide their services sustainably.

One accounting system, three levels of assessment

A second characteristic of ecosystem accounting, due in part to the fact that its variables are not numerical, as well as to other more general considerations, is the existence of several levels of assessment. The work carried on over a number of years at the European Environment Agency (EEA) has led to the conclusion that there are at least three levels of application, each defined in terms of geography, levels of decision-making and key types of economic, social and scientific information. These three levels interact and must be formally linked via variables which possess the same significance on the three different levels.

(41) Rapport, D. J., Whitford, W. G., 1999. "How ecosystems respond to stress". BioScience 49 (3), 193-203.
(42) Weber, J.-L., 2007. "Implementation of land and ecosystem accounts at the European Environment Agency". Ecological Economics 61 (4), 695-707.

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One example of the problems posed by these multiple levels is offered by the EEA's methodological study of Mediterranean wetland accounting. A recent study undertaken for UNEP on bird flu shows that two factors need to be taken into account: (a) farming techniques and hygiene conditions in many parts of the world and (b) the loss of wetland due to urban sprawl and drainage for agriculture. Bird flu is mainly transmitted by migratory birds, most of which depend on wetlands for their habitat. The gradual disappearance of the wetlands means that the flyover corridors are narrower, resulting in more contamination passed from bird to bird. Migrating birds are also forced to disperse and to alight in duck ponds on farms, potentially contaminating the poultry. The risk of a pandemic is taken very seriously by the WHO, FAO and the insurance companies. In a 2007 publication, "Pandemic, Risk Trading, Geographical Information Systems", the Munich Re Group cites studies of the costs of major pandemics such as the "Spanish flu" of 1918-1919 (though it urges caution in the use of these statistics). Estimates of their economic costs vary between 1% and 10% of global GDP. In February 2008, the Munich Reinsurance Company issued a US$1.5 billion bond to transfer the risk of a major pandemic to the capital markets. Around the same time, discussions were initiated to obtain European Community funding to reorganise the management of a national park in Greece; when only local concerns were taken into consideration, the operation - vital to restore the park's ecological functions - was judged too expensive. Taking into account its global regulatory role in reducing the risk of a pandemic would probably have led to a different decision.

These three levels of application are:

- The action level: development projects, local authorities (local government, agencies), businesses, citizens;
- The government level: collective decision-making and major decisions, the definition, implementation and monitoring of policies at regional, national and supranational levels;
- The global level: major goals (international agreements, UN, WTO, OECD, G8), control and regulation of the global market, the global ecosystem.

The action level

At the action level, economic ecosystem accounting will use charts of accounts to list the items necessary for incorporating environmental costs and benefits more accurately into decision-making. With respect to the direct management and use of a particular ecosystem, the physical accounting of its natural assets is based on the best available scientific knowledge, enabling effective action on the operational variables of each particular ecosystem. Indirect or ancillary costs (purchases of intermediate goods) are measured using more synthetic indicators, such as "human appropriation of net primary productivity" (HANPP), consumption of ecological potential and virtual use of land and water.

The accounting of the actual monetary costs of maintaining ecosystems is combined with a depreciation computation corresponding to the amount to be reinvested to maintain the natural capital in working order. The principle here is that of environmental compensation, as defined either by the system put forward in the 2004 European Directive on environmental liability or by the American system of compensation banks or grants. It does not involve an "eye for an eye" form of restitution to damaged or destroyed ecosystems, but rather a contribution to the re-creation of ecological potential of the same

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kind and quantity (compensation) in a region, a river system, a country or the world as a whole. This ecological potential is one of the multi-level variables mentioned above. Knowledge of the full cost of the products they sell, including the additional (unpaid) cost of maintenance or rehabilitation of the exploited domestic or foreign ecosystems, is an important piece of information for businesses and could usefully be brought to the attention of consumers (for example, by showing a breakout of prices on goods for sale).

The third component of ecosystem accounting is that of services. Here the goal is to measure as completely as possible the benefits provided by ecosystems, so as not to make mistakes in the economic calculation of the benefits of a particular project. Although in principle the direct profits expected to accrue from operations are clearly definable, the services ecosystems provide at no charge to individuals or communities are often ignored or viewed merely as environmental constraints. Public authorities ought to emphasise the importance of these services, especially regulatory services. Private businesses or individuals can benefit from opportunities to enhance ecosystem functions of major potential. Medicinal plants are an often-cited example of opportunities to develop markets for ecosystem services, since they represent mixed capital, combining configurations of molecules (partly resistant to chemical analysis) and local populations' traditional knowledge of their useful properties. Monetary-based methods of valuation have been developed in the past thirty years through a large number of case studies. Over time, it has been shown that each of these methods has quite strict conditions of validity; an ecosystem accounting system ought to provide the documentation necessary for the proper use of these methods.

The government level

At the government level, ecosystem accounting should be viewed in terms of its use for supervision, the specific levels of intervention required and its role in global governance.

Their support for economic players should lead governments, including the European Commission, to promote the implementation of ecosystem accounting as described above. Charts of accounts for local businesses could usefully benefit from a set of established rates and prices, both for the costs of maintenance and rehabilitation and for the (pro-forma) costs of ecosystem services. In addition, multi-level indicators on the same geographical scale as their own operations should be calculated and provided, to enable them to evaluate and compare their costs.

With respect to environmental economic accounting, the government level has the job of implementing a complete accounting system "Beyond GDP" (to borrow the title of the high-level conference organised by the European Parliament and Commission in November 2007). This involves in particular the integration of economic and social statistical data and of the large scientific databases on the nature and monitoring of the environment. Given the need to work in terms of the different levels, some of the data could usefully be broken out into kilometre cells, using the standard European grid. Current work is going forward in the context of the revision of the UN's integrated environmental economic accounting system (SEEA 2003), expected

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to be completed in 2012, and of the European environmental accounting strategy which is to implement the SEEA in Europe.

Some sets of accounts for ecosystem services have already been published in India, and in 2006 the European Environment Agency published the accounts for land areas[43] based on satellite images, to be updated in 2009. The EEA is testing ecosystem accounts as part of a study of the economics of ecosystems and biodiversity (in response to a request from the G8+5 in 2007), and of the assessment of European ecosystems and their services (Eureka!, the European component of the second Millennium Ecosystem Assessment), in support of the UNEP initiative for international payment for ecosystem services and in the context of the expansion of national accounting systems, the revision of SEEA 2003.

The global level

World-wide ecosystem accounting is a simplified accounting system restricted to multi-level accounts. These accounts should include the following indicators: the ecological potential of landscapes, biodiversity (index of the specialisation of communities of species), human appropriation of net primary productivity (HANPP), urban pressure, intensive agriculture pressure, consumption of virtual land and water, water systems' energy loss and the additional costs of maintenance and rehabilitation of ecosystems to sustain their potential at the level agreed on under international conventions. Global ecosystem accounting could be started up quickly, drawing on the Earth observation programmes which combine satellite observation (here a recent advance is the GlobCover programme of the European Space Agency, which provides information for possible use in the implementation of global land cover accounting), in situ monitoring and modelling, particularly in connection with the study of climate change.

Conclusion

A variety of complementary programmes are beginning to be introduced. The importance of effective co-ordination of the various sets of accounts on different levels must be emphasised, with the implication that the central levels must provide data relevant to the level of operations and at the same time that ecological, economic and social information gained in the field can be sampled to sustain the aggregated sets of accounts.

(43) EEA, 2006. "Land accounts for Europe 1990-2000", EEA Report No 11/2006 prepared by Haines-Young, Roy and Weber, Jean-Louis: http://reports.eea.europa.eu/eea_report_2006_11/en.

4.1.9 DEVELOPING ECOSYSTEM ACCOUNTING: FROM THE BIOSPHERE AND NATION-STATES TO BUSINESSES AND INDIVIDUAL PROJECTS

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Following the International Conference on "Biodiversity: Science and Governance" in January 2005, a consultative process was initiated, charged with assessing the need, form and possible configurations of an International Mechanism of Scientific Expertise on Biodiversity (ImoSEB), based on the existing one on climate change (IPCC/GIEC).

The process was directed by an International Steering Committee and an Executive Committee, and one of its first acts was the launching of several case studies[44] (on emerging diseases, traditional knowledge, Mexico) in order to identify and define existing needs and gaps at the interface of science and biodiversity policy and to propose a number of options for a future mechanism.

Based on these findings and proposals, a series of regional consultations was organised between January and October 2007 (in North America, Africa, Europe, Asia, Latin America, the Pacific). They brought together stakeholders in biodiversity of all kinds, with over 300 people from 70 countries and 40 regional and international organisations, for the purpose of gathering local opinions, comments and considerations and proposing new options for the mechanism.

In the course of these regional consultations, participants repeatedly brought up the essential role that the private sector could play, both in the management of biodiversity and the increase of scientific knowledge relating to certain biomes. This has led to the inclusion of businesses in discussions on the organisation and governance of a future mechanism. Private sector representatives invited to the European regional consultation pointed out the importance of biodiversity in many sectors, the need for more integrated management and the roles and goals which such a mechanism could fulfil. The mechanism would: synthesise in a suitable format data and scientific results for the use of the business community and civil society; be oriented towards decision-makers and their needs and concerns; and introduce socio-economic tools and indicators to help with decision-making.

Through the regional consultations[45] two key needs have been defined, namely:

- Improving the interface between knowledge and decision-making, so as to better identify research priorities with respect to biodiversity;
- Making more productive use of scientific expertise so as to offer accurate answers to questions posed by decision-makers in both the public and the private sphere.

At the closing meeting of the Steering Committee[46], the creation of a new mechanism at the interface of science and politics was envisaged. The goal of this mechanism is to make scientific expertise on biodiversity available to all kinds of decision-makers, public and private, drawing on an existing meta-network of scientists and knowledge owners. It would also have the capacity to offer scientific expertise on specific issues at short notice, especially in situations of ecological crisis (new diseases, invasive species).

To meet these needs, a hybrid structure is envisaged, with a large inter-governmental component, which

(44) These case studies are available at http://www.imoseb.net/case_studies.
(45) The results of the regional consultations are available at http://www.imoseb.net/regional_consultations.
(46) The closing statement is available at http://www.imoseb.net/international_steering_committee_2.

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will also include other stakeholders in biodiversity. At the request of members of the Steering Committee, an approach was made to those in charge of the continuance of the Millennium Ecosystem Assessment, an international initiative aimed at assessing the consequences of ecosystem change for human well-being. A common strategy needs to be defined for the establishment of this new organisation.

Drawing on a network of experts and with the support of France, Germany, Sweden, the European Commission and UNEP (United Nations Environment Programme), an international discussion of the creation of an Intergovernmental Science-Policy Platform for Biodiversity and Ecosystem Services (IPBES[47]) resulted in a commitment to determining the precise goals, accomplishments and modes of operation of this Platform.

Initial support from the international community for the Platform was expressed at the 9th Conference of Parties to the Convention on Biological Diversity in Bonn (Germany) in May 2008.

An international conference addressed to all stakeholders in biodiversity will be held in Kuala Lumpur from 10 to 12 November 2008. Its task will be to define their modes of organisation and participation in this Platform.

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(47) http://www/ipbes.net.

CONCLUSION

The work of the *Orée*-IFB Working Group has shown that biodiversity underpins a very large number of businesses. The self-assessment reports compiled using the criteria of the *Business and Biodiversity Interdependence Indicator* (BBII) present various organisations' own perceptions of their interdependence with biodiversity. They have to realise that the economy as a whole interacts, directly and indirectly, with living systems. Their interactions with biodiversity

- Take place, explicitly or otherwise, on a number of levels, from industrial sites to surrounding areas, from the local to the international level, from production units to company headquarters, and from subsidiaries to parent organisations;
- Affect numerous functions and skills within organisations, from innovation to production cost control, accounting to taxation, management of social pressures to business or supply strategies, and from public relations to training of employees.

We are witnesses and participants in the co-evolution of ecosystems and socio-economic systems. Some species, those which provide us with direct economic or cultural benefits, have been actively selected by humans for millennia; monocultures and livestock farms are examples. These organisms have adapted to our selective pressure and in turn influence our choices and ways of life. The overt or unconscious motivation for this selective co-evolution (which has led to the competitive exclusion of a myriad other species over increasingly wide areas) seems to be the "necessary" control of the unforeseen, of the variability and complexity characteristic of ecosystems and biodiversity, in order to produce more, live better and thus meet our "needs" of development. But this quest for absolute control, for optimising the transformation of raw materials derived from the living world, depends on social choices and is based on value systems.

Today's research shows that diversity and variability are the true insurance policies for the success of life on our planet, for they underpin the (free of charge) ecosystem services our economy rests on. How should we rethink the dynamics of interaction between businesses and living systems which now contribute to the increasing erosion of biodiversity? An organisation may seek to co-evolve with ecosystems in the design and manufacture of its products, for example by using a life-cycle assessment but adopting the Carbon dioxide equivalent (CDE) as the leading indicator. We cannot speak of co-evolution with biodiversity in cases of this sort, since this indicator relies on a reductive view of the evolution of ecosystems. Industrialisation today simplifies and impoverishes ecosystems: production choices and processes homogenise biological diversity. Technical, organisational and institutional innovation is elevating biological uniformity to the status of an absolute, universal model: businesses and all other economic agents, including consumers and governments, share the responsibility for the global homogenisation of living systems.

It is commonly supposed that biodiversity can be sustained by putting a price on it. In reality this is a counterproductive approach. This is allegedly achieved via off-market assessment techniques which have serious methodological limitations, for instance contingent valuation methods in which protocols cannot be replicated or results compared either geographically or temporally. In spite of the best efforts of economists, biodiversity is essentially irreducible to the categories of "goods", "services" and "capital". Ecosystems underpin economic activity (energy, organic and inorganic mater consumption) and our ways of life (climate and landscape variability, both living and non-living resources), which in turn affect ecosystems, their dynamics and the evolution of their living components. Cultural and biological diversity cohabit and coevolve within one single world-wide living system, the biosphere. We must acknowledge that biodiversity is our first insurance policy in an uncertain world, where changes and surprises in ecosystems are the norm. We need to move away from the approach in which it is biodiversity that needs to be integrated into the economy, towards the reintegration of economy activity into the diversity of life, into living – hence diversified – ecosystems. The situation is urgent, and we need to shorten the time that was needed for the institutionalisation of climate change issues in order to reconcile economic activity with biodiversity[1]. The goal is to stimulate economic agents, with businesses in the forefront, to work actively on creating new methods, tools, products and services *"to team up with life"*, in the words of Robert Barbault.

How are we to get beyond the arbitrariness of the debates which rely on an opposition between business competitiveness and pro-biodiversity measures? How are we to manage the interactions between the precautionary principle, risk prevention and free enterprise? Planning for a viable model of development in the long term comes down to planning the most effective management of the interactions between different sources of variability, both natural and social, with very long-term goals in mind. We need to move on from measuring sustainable exploitation levels and work on understanding the dynamics of the interactions between resources and their users. This is the perspective on which our proposed model of co-evolution of businesses and ecosystems is based: we refer to it as the *co-viability of biodiversity and businesses.* Human beings, businesses and the global economy must be re-integrated into the diversity of living systems. We propose to overturn the uniformity model and to build together a new model of development based on the growth and globalisation of the diversity of living systems, to be applied to every product, service and activity. This involves:

- Asking how we can guarantee the viability of biodiversity through the direct and indirect relationships between businesses and living systems, without compromising businesses' financial viability; in other words, how can we make profit an instrument for the diversification of the living world while making biodiversity a source of increased profits?
- Enhancing via technological, organisational and institutional innovation the "biological roulettes" which underpin the evolutionary dynamics of all living systems in the biosphere which human beings depend on and form part of. Businesses need to go beyond avoiding, reducing or compensating for inevitable environmental damage. Once interdependence is an accepted and valued principle, we can move from a system of external constraints based purely on national or international public policy or regulations to a system in which we teaming up with life means choosing its diversity and its virtues in the (models of) production of goods and services;
- Adopting an ecosystem-based conception of value-added creation through industrial processes, economic dynamics and modes of regulation, transcending national and legal boundaries and focusing directly on access to resources, their uses and modes of appropriation.

(1) Why is climate change important ? Because it determines the continuance of human life on Earth. But the evolution human life is equally shaped by biodiversity, whose erosion is due primarily to human activity and relatively very little to climate change, which itself is the result of human activity (Weber, personal communication, 2008).

The co-viability of business and biodiversity also offers some simple rules for managing the complexity and uncertainty of biodiversity. A primary goal is to eliminate situations of free access to resources, regardless of the regime of property rights in place. Businesses have a role to play in this respect, both at the level of the land they own and the ecosystems from which they derive ecological services. A second goal is to find ways to generate positive externalities on both a local and global scale: businesses need to actively participate in the establishment of efficient and socially equitable management systems at all appropriate levels, depending on the object of study or problem at hand. Strategies devised merely to circumvent collective challenges should be avoided; instead, technological, organisational and institutional innovations could lead to the local adaptive co-management of ecosystems, without causing irreversible consequences at a global scale. Businesses would come to investigate and understand the ecological and social consequences of each of the property rights (access, use, land, resource) related to biodiversity which they own or depend on, as well as the consequences of their business and appropriation strategies related to living systems.

Achieving the co-viability of biodiversity and businesses will often require an entirely novel approach of doing business. How are we to guide the socio-economic systems, which now promote the homogenisation of living systems, towards this new goal? Changing business practices and modes of innovation and appropriation might be characterised as a particularly risky gamble for those concerned, for it directly affects their economic viability. The stages of transition to the co-viability of biodiversity and businesses will need to be managed in the best possible way, both individually and collectively. Economic time, the time needed to modify behaviours and the time needed for the hoped-for feedback to occur within an ecosystem are not on the same scale, hence the need for public support policies. Accounting and financial instruments will have to be developed for the globalised world of business, reaching beyond international borders and suited to the viability constraints of businesses. These would complement the existing range of tools – and those now being fine-tuned – which aim at ensuring the viability of the diversity of living systems; networks of protected areas and ecosystem accounting are two examples of these.

Thinking in terms of interdependence with biodiversity produces two outcomes. In the case of "strong" interdependence, a business's impacts on biodiversity cease to be an external constraint on its activity, which can consider it as a normal cost, offset by normal profits: it becomes an integral part of the business's standard operations. Looking at the costs and benefits associated with the reintegration of the economy into biodiversity then becomes a normal way of doing business. This situation also calls for the introduction of a new accounting system, complementing the existing framework, which takes account of the relations between business and living systems. The methodology of the "Bilan Carbone" measures the amount of greenhouse gases emitted by all the physical processes required to sustain specific human activities or organisations, insofar as their boundaries are clearly definable. However, it does not, and is not designed to take account of the interactions between living systems and the world of business. To assist businesses to reduce the rate of erosion of biodiversity by 2010, we propose a practical instrument to account for their relations with living systems, after presenting the underlying principles of the technical, organisational and institutional innovations necessary for the co-viability of biodiversity and businesses. This is the *Biodiversity Accountability Framework,* an interdisciplinary

accounting system structured to highlight and delimit the responsibility of organisations to ecosystems. It aims to introduce consistency into the proliferation of initiatives, often contradictory and split up by industry sector, in order to take socio-ecological issues into account. Although it can be adapted to all organisations - businesses, administrations, local government and non-profits - our focus here is on businesses. The *Biodiversity Accountability Framework* falls into two inseparable parts:
Part A: Ecosystem accounting for business;
Part B: Ecosystem accounting for the relationships between businesses.

The global and local governance of biodiversity raises fundamental issues which will make businesses' responsibility for ecosystems a central topic of discussion. As Jacques Weber (2002b) points out in an article written in preparation for the World Summit on Sustainable Development in Johannesburg, the totality of ecological, social and economic concerns are brought together in this topic. Yet, businesses will never find it "rational" to integrate their strategies and operations into biodiversity as long as biodiversity has no economic "value" and there is no cost, at least apparently and in the short term, to destroy or homogenise it. To change this situation, institutions, both incentives and disincentives, are needed which will make implementation of the *Biodiversity Accountability Framework* profitable, throughout supply chains and at each stage of value-added creation. Our world-wide taxation system has to adapt to the living world. Sooner or later we will have to halt the trend towards encouraging more environmentally responsible behaviour via new taxes added on top of pre-existing ones: a radical change in modes of regulation is called for, a move from a taxation system based on human and manufacturing capital to a completely different system based on the consumption of nature.

The time has come to launch partnerships and constructive projects for the co-viability of biodiversity and businesses. Future research could focus on modelling ecosystem accounting for a business, a local government or a specific industry. This would help to identify the levers of action to be used to convince all economic entities, consumers and citizens, academia and governments, to become involved in ecosystem accounting for relations between organisations. How substantial the return on investment will be if the gamble on the co-viability of biodiversity and businesses is a success!

APPENDICES

Categories	Designed to assess:		
Criteria directly related to living systems	dependence on raw materials	C1.1	
	dependence on services and technologies derived from living systems	C1.2	
		C1.3	
	management of the variability, health and complexity of ecosystems	C1.4	
		C1.5	
		C1.6	
Criteria related to current markets	dependence of company profits on biodiversity	C2.1	
		C2.2	
		C2.3	
Criteria related to impacts on biodiversity	impacts of company operations on living systems	C3.1	
		C3.2	
		C3.3	
		C3.4	
		C3.5	
Criteria related to compensatory measures	offset measures	C4.1	
		C4.2	
		C4.3	
Criteria related to business strategies	the company's strategic positioning	C5.1	
		C5.2	
		C5.3	
		C5.4	
		C5.5	
		C5.6	

	Criteria	Self-assessment				
		Not / lightly concerned		Moderately / highly concerned		Reason(s)
		1	2	3	4	
	C1.1.a percentage of raw materials derived from living systems					
	C1.1.b percentage of raw materials derived from living systems of past era					
	utilisation of ecological services (including biotechnologies)					
	bio / eco-mimetism					
	ecosystem variability					
	ecosystem health					
	ecosystem complexity					
	cost of raw materials derived from biodiversity as a fraction of the total production cost					
	market positioning (quality level linked to marketing biodiversity)					
	volume of sales of goods and services derived from biodiversity as a fraction of the total volume of sales					
	reversibility of impacts					
	alteration of the landscape					
	pollution, emissions, waste generation					
	selective pressures and species' viability					
	ecosystem fragmentation					
	legally required compensation measures related to the impacts of the activity					
	voluntary compensation measures related to the impacts of the activity					
	monetary compensation not directly related to the impacts of the activity					
	importance of biodiversity for the viability of the company (going concern)					
	social pressures					
	increased competitiveness					
	effects of public relations efforts					
	creation of new markets					
	corporate culture					

Categories	Designed to assess:		
Criteria directly related to living systems	dependence on raw materials	C1.1	
	dependence on services and technologies derived from living systems	C1.2	
		C1.3	
	management of the variability, health and complexity of ecosystems	C1.4	
		C1.5	
		C1.6	
Criteria related to current budget	dependence of the organisation's budget on biodiversity	C2.1	
		C2.2	
		C2.3	
Criteria related to impacts on biodiversity	impacts of the local government on living systems	C3.1	
		C3.2	
		C3.3	
		C3.4	
		C3.5	
Criteria related to compensatory measures	offset measures	C4.1	
		C4.2	
		C4.3	
Criteria related to the local government's strategies	the local government's strategic positioning	C5.1	
		C5.2	
		C5.3	
		C5.4	
		C5.5	
		C5.6	

	Criteria
	C1.1.a percentage of raw materials derived from living systems
	C1.1.b percentage of raw materials derived from living systems of past eras
	utilisation of ecological services (including biotechnologies)
	bio / eco-mimetism
	ecosystem variability
	ecosystem health
	ecosystem complexity
	cost of raw materials derived from biodiversity as a fraction of the total budget
	attractivity of the area under its responsibility
	budget allocated to biodiversity as a fraction of the total budget
	reversibility of impacts
	alteration of the landscape
	pollution, emissions, waste generation
	selective pressures and species' viability
	ecosystem fragmentation
	legally required compensation measures related to the impacts of the organisation
	voluntary compensation measures related to the impacts of the organisation
	monetary compensation not directly related to the impacts of the organisation
	importance of biodiversity for the viability of the organisation
	social pressures
	increased area competitiveness and attractivity
	effects of public relations efforts
	creation of new markets within the area under its responsibility
	cultural impacts

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Agro-forestry: land use systems and practices in which trees are deliberately mixed with crops and / or animals in the same land management unit, thus promoting diversity.

Agro-system: ecosystem dominated by continuous human intervention for the production of animal or plant species for food production (crops, livestock), industrial (sugar-beet) and energy (ethanol) purposes.

Appropriation: The act of appropriating something. In the case of biodiversity, we cannot own genes but only the rights of access to and use of genes for a predetermined period (usually 25 years). There is no ownership of living entities, only the development of markets for trading such rights. Indeed, patents, which are exclusive temporary rights of access to and use, do not constitute "ownership rights". Property rights include rights of use, rights of benefiting from and rights of "abusing" the item or object owned ("usus, fructus, abusus").

Asset: item owned by an economic entity or agent (a household, a business) with positive economic value: a resource which the entity controls as a consequence of past events and which is expected to generate future economic advantage.

Benthic and pelagic populations: benthic species live in the lowest levels of a body of water, including the sediment surface and some sub-surface layers, from the shoreline to the depths of the ocean; pelagic species live in the water between the benthic zone and the surface.

Biocoenosis: all the interacting organisms living together in a specific habitat (or biotope).

Biomass: the total quantity of matter (mass) of all living species present in a given environment. The term includes all organic material with the potential to become a source of energy.

Biosphere: the global, self-sustaining ecosystem which includes all living things and their relationships, both to one another and with the hydrosphere (water), the atmosphere (air) and the lithosphere (rock), in a metabolism which continuously affects these three spheres by modifying, storing or recycling them.

Biotope: an area of uniform environmental conditions providing a living space for a specific assemblage of plants and animals. Biotope is almost synonymous with the term habitat, but while the subject of a habitat is a species or a population, the subject of a biotope is a biological community (biocoenosis).

Carbon dioxide equivalent: a measure for describing how much global warming a given type and amount of greenhouse gas may cause, using the functionally equivalent amount or concentration of carbon dioxide (CO_2) as the reference. It describes, for a given mixture and amount of greenhouse gas, the amount of CO_2 that would have the same global warming potential (GWP), when measured over a specified time scale (generally, 100 years). For example, the GWP for methane over 100 years is 23, meaning that 1 tonne of methane corresponds to 23 equivalent tonnes of CO_2.

Carrying capacity: in population dynamics, a sub-field of ecology, the number of individuals in a habitat which can be maintained for an indefinite period of time, given the resources available. The Lotka-Volterra equation models a type of carrying capacity.

Co-adaptation: the reciprocal adaptation of two or more species, genes or parts of an organism for a given function. Co-adaptation does not require co-evolution: two reciprocally adapted bodies may have evolved completely independently.

Co-evolution: the reciprocal evolutionary influence of two or more species on each other. Each entity exerts evolutionary pressure on the other and evolves in turn in response to pressure from the other. Businesses affect the evolution of ecosystems, which in turn affect businesses.

Compensatory measures: in French environmental law, operations, management practices or intangible procedures (training and consciousness-raising of a site's users or managers) designed to compensate for the loss of an ecologically important area or element. They are imposed when measures for eliminating or mitigating the negative ecological impacts of a project have failed.

Competitive exclusion (Gause's Law): in population ecology, a theory which states that two species competing for the same resources cannot coexist in a stable way if the ecological factors are constant. One of the two competitors will always take over the other, which leads to either the extinction of one of the competitors or its evolutionary or behavioural shift towards a different ecological niche. The erosion of biodiversity is caused largely by humans, who cause competitive exclusion over increasingly large areas.

Contestable market: a market in which potential competition (threat of new market entrants) garantees competitive prices, even though the market is in reality dominated by a single or a few firms. Its fundamental feature is low barriers to entry and exit; a perfectly contestable market would have no barriers to entry or exit.

Decarbonisation: the promotion of new energy sources, replacing carbon-based (fossil-fuel) sources, and of their more efficient use.

Dematerialisation: a strategy for reducing the amount of resources used to perform a service without diminution of the service, by closing the energy and matter cycle.

Discount rate: used to calculate the present value of a future given value: for example, how much would a sum of 1000 euros in 2050 be worth today? The discount rate is the inverse of the interest rate. The Stern Report argues for applying a discount rate of 1.4% to estimate the cost of climate change by 2050, in the absence of intervention.

DNA (deoxyribonucleic acid): a macromolecule composed of two long polymers of simple units called nucleotides. It contains the genetic instructions used in the development and functioning of all known living organisms and some viruses. The main role of DNA molecules is the long-term storage of information.

DNA repair: a collection of processes by which a cell identifies and corrects damage to the DNA molecules that encode its genome.

Duration of asset engagement: period of time necessary to make an asset profitable under normal economic conditions. The premature withdrawal of the asset would result in a net loss, which means that it is not possible to exit the market easily under difficult circumstances.

Ecological economics: an interdisciplinary field which studies the dynamics and spatial interdependence of human economics and ecosystems. Ecological economics brings together a number of disciplines in the social sciences, economics and natural sciences. Ecology includes economics, not vice versa.

Ecological niche: the relational position of a species or population in its ecosystem; it describes how an organism or population responds to the distribution of resources and competitors and how it in turn alters those same factors.

Ecomimetism: making use of the essential properties of one or more ecological systems to solve human problems; biomimetism is similar, but makes use of a single living organism.

Ecotone: a transition area between two adjacent ecological communities (ecosystems) such as savannah and forest or lake and dry land. It may manifest as a gradual blending of the two communities across a broad area, or as a sharp boundary line.

Environmental dumping: the practice of shipment of waste (household, industrial, nuclear) from one country to another with less strict environmental laws, or environmental laws that are not strictly enforced. The economic benefit of this practice is cheap disposal or recycling of waste without the economic regulations of the original country.

Ecological engineering: the application of science and engineering principles to improve the environment (air, water, and / or land resources), to provide healthy water, air and land for human habitation and for other organisms, and to remediate polluted sites. It can draw upon the mechanisms governing ecological systems. Several definitions of the term exist across scientific disciplines.

Environmental liability: a charge (expenditure) assigned as a liability on a business's financial accounts when it is probable that the settlement of a present obligation, environmental in nature and resulting from past events, will produce an outflow of resources without an at least equivalent inflow, and that the amount of this charge can be reliably estimated.

Epigenetics: the study of hereditary changes in gene function. These changes occur without altering the DNA sequence; they are not accompanied by changes in the organisation of nucleotide sequences. In the "'epigenetic landscape", genes are only one factor among others. DNA methylation and environmental impacts are examples of epigenetics.

Externality: an impact on any party not directly involved in an economic decision. An act of consumption or production has a positive or negative impact on another entity not involved in the act, without the latter entity being fully compensated for the damage or required to pay for the benefit which results.

Food chains: also called food networks and / or trophic networks, are the feeding relationships between species within an ecosystem in which energy and matter circulate, specifically the flow of carbon and nitrogen between the different levels of the food chain, and carbon exchange between heterotrophic and autotrophic organisms.

Gametes: haploid reproductive cells which undergo meiosis and cytoplasmic differentiation. In species which produce two morphologically distinct types of gametes, and in which each individual produces only one type, a female is any individual which produces the larger type of gamete—called an ovum (or egg)—while a male produces the smaller type—called a sperm.

Gene: a deoxyribonucleic acid (DNA) sequence which occupies a specific location on a chromosome and determines a particular characteristic in an organism. The ultimate expressions of gene function are the formation of structural and regulatory ribonucleic acid (RNA) molecules and proteins. These macromolecules carry out the biochemical reactions and provide the structural elements that make up cells.

Gene therapy: the insertion of genes into an individual's cells and tissues to treat a disease, by replacing a defective mutant allele with a functional one, or via an over-expressed protein whose activity has a therapeutic effect.

Genetic erosion: the reduction of genetic variability and the gradual degradation of processes which ensure the evolution of diversity.

Genetic mixing: takes place during sexual reproduction; through meiosis and fertilisation it generates new arrangements of genetic material in each generation. Meiosis produces the inter- and intra-chromosome mixing which is at the genesis of reproductive cells, or gametes. In fertilisation gametes are fused to produce an egg or zygote.

Genome: The total genetic content contained in a haploid set of chromosomes in eukaryotes, in a single chromosome in bacteria, or in the DNA or RNA of viruses.

Green and blue threads: in France, an environmental management plan in which the "green thread" consists of large natural areas linked by ecological corridors which can also serve as buffer areas, complemented by the 'blue thread', rivers and other bodies of water and their banks. The goal is to create ecological continuity throughout the country. These threads are designed to connect protected areas together and enable many species to migrate north in response to climate change.

Green revolution: the technological leap in agriculture during the period 1944-1970, following up on scientific advances made before World War II. It was made possible by the breeding of new high-yielding crop varieties, especially cereals (wheat, rice). The use of inorganic fertilisers, pesticides, mechanisation and irrigation is also involved. The result is a dramatic increase in agricultural productivity. Beginning in 1994, Gordon Conway and the Advisory Group on International Agricultural Research have proposed the development of a "doubly green revolution", which makes use of ecosystems without jeopardising their survival.

Greenwashing: a term used to describe the perception of consumers that they are being misled by a company regarding the environmental practices of the company or the environmental benefits of a product or service. It is a deceptive use of green PR or green marketing.

Heterotrophic: a heterotrophic organism utilises organic compounds to obtain carbon essential for growth and development. Examples of such organisms are animals, which are not capable of manufacturing food from inorganic sources, and must consume organic substrates for sustenance. An autotrophic organism produces organic matter through the reduction of inorganic matter such as nitrogen or carbon.

Horizontal gene transfer: any process in which an organism incorporates genetic material from another organism without being the offspring of that organism; very common among bacteria. Transformation (the introduction, uptake and expression of foreign genetic material, either DNA or RNA) is distinguished from conjugation (exchange of plasmids between bacteria) and transduction (exchange via a virus).

Indigenous species: a species originating in the region where it is now present, and adapted to its environment.

Industrial ecology: an interdisciplinary field which focuses on the sustainable combination of the environment, economy and technology. The central idea is the analogy between natural and socio-technical systems (ecomimetism). It involves the shifting of industrial processes from linear (open loop) systems, in which resource and capital investments move through the system to become waste, to a closed loop system where wastes become inputs for new processes.

Inorganic: any substance which does not contain both carbon and hydrogen.

Institution: any arrangement between at least two individuals or groups which is recognised beyond these individuals or groups. For example, marriage is an arrangement between two persons which is recognised by all.

Institutionalisation: process of defining and codifying rules, resulting from compromises agreed on by those concerned. Alternatively, the transition from an informal or experimental practice to one that is more formal, organised and, most importantly, socially recognised. According to Dewey (1927), there are three key moments in the formation of a public arena in political life: analysis of problematic situations (problematisation), institutionalisation, and dissolution.

Intangible asset: non-monetary asset which is identifiable and durably usable but non-physical (such as a patent or leasing rights).

Invasive species: a species, often exotic, which interferes with and damages the indigenous biodiversity of the ecosystems within which it has become established.

Life cycle analysis (LCA): the assessment of the environmental impact of a product, service or process throughout its life cycle, from initial design to disposal at its end-of-life.

Metagenome: all the genetic material present in an environmental sample, consisting of the genomes of many individual organisms.

Mycorrhizae: symbioses between a fungus and the roots of a plant.

Natura 2000: European nature conservation programme with the dual goal of preserving biological diversity and improving the attractiveness of the landscape. A network of sites is spread across Europe, in a systematic continent-wide initiative. In France, the Natura 2000 network covers 6.8 million hectares, or 12.4% of the total land area, and includes more than 1,700 sites.

Nucleotides: organic compounds consisting of three joined structures: a nitrogenous base, a sugar, and a phosphate group. The most common nucleotides can be divided into two groups (purines and pyrimidines) based on the structure of the nitrogenous base. The joined sugar is either ribose or deoxyribose. Nucleotides are the structural units of RNA and DNA.

Organic: said of a molecule composed of carbon atoms, the defining feature of living organisms.

Point mutation: a permanent and stable mutation affecting a small number of nucleotides of the DNA molecule, within or outside a gene.

Precautionary principle: *"If an environmental risk is known, we cannot invoke the lack of scientific certainty not to decide".* The precautionary principle results in action, not inaction, contrary to what is commonly supposed.

Prevention principle: allows action to be taken to protect the environment at an early stage from risks whose existence is proven or known empirically, sometimes so fully that we can estimate the likelihood of their occurrence (nuclear accidents, asbestos, smoking). The uncertainty does not relate to the risk itself, but to the likelihood of its occurrence.

Renewable energy: energy that is regenerated or renewed naturally, indefinitely and inexhaustibly as measured on a human time scale (billions of years). Whether a form of energy is renewable depends on the speed at which its source regenerates and that at which it is consumed.

Resilience: C. S. Holling was the first to introduce this term into ecology in 1973. Others have since defined it as the time required for a system to return to a stable equilibrium after a period of stress or exogenous disruption. For Holling, resilience is *"the capacity of an ecosystem to tolerate disturbance without collapsing into a qualitatively different state that is controlled by a different set of processes. A resilient ecosystem can withstand shocks and rebuild itself when necessary."* On this view, there is no steady state for a single system, whatever its nature. Resilience is defined as the system's adaptive capacity to resist disturbance, rather than change its state and thus modify the variables and processes that govern its own evolution.

RNA (ribonucleic acid): a polymeric constituent of all living cells and many viruses. The structure and base sequence of RNA are determinants of protein synthesis and the transmission of genetic information.

Sustainable development: *"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs",* in the words of the Brundtland Report (1987). This definition relies on a concept of intergenerational equilibrium and sustained yield. It is based on a view of nature as an inventory or stock, to be managed optimally, a concept which inevitably leads to hair-splitting distinctions between "strong" and "weak" sustainability, depending on the discount rate adopted. Weak sustainability upholds the perfect substitutability of different forms of capital (human, social, manufacturing, natural), with the implication that it would be rational to destroy biodiversity to sustain indefinitely economic development.

Systems ecology: an interdisciplinary sub-field of ecology with a holistic approach to ecological systems, including industrial systems. It applies general systems theory to the field of ecology. In effect, systems ecology adopts and extends the concepts of thermodynamics and complex systems.
Thermodynamics: the study of the transformation of energy into different forms and its relation to variables such as temperature, pressure, and volume.

Viability: a mathematical theory in the field of partial differential equations, by Jean Pierre Aubin. A domain of viability is sought which contains the path of a system in infinite time. Any path near the limit of this domain tends away from the "domain of viability". The problem to be addressed is the discovery of the control variables to be manipulated to return the path of the system back towards the "viability kernel". Interaction is the keyword of life, and thus we are concerned with the co-viability of evolving systems (ecosystems, living systems, industrial systems).

Viral vector: a tool commonly used by molecular biologists to deliver healthy genetic material into cells via viruses, to replace defective genes. The development of gene therapy relies mainly on the development of systems for gene transfer.

ACRONYMS

ADEME : Agence de l'Environnement et de la Maîtrise de l'Energie

AOC : Appellation d'Origine Contrôlée

BBII : Business and Biodiversity Interdependence Indicator

CAP : Common Agricultural Policy

CBD : Convention on Biological Diversity

CDM : Clean Development Mechanism

CITES : Convention on International Trade in Endangered Species

CoP : Conference of Parties

CSR : Corporate Social Responsibility

EMAS: Eco-Management and Audit Scheme

EMS : Environmental Management System

EPIC: Entreprise Privée à caractère Industriel et Commercial

FAO: Food and Agriculture Organization

FNE: France Nature Environnement

FSC: Forest Stewardship Council

GIS : Geographic Information System

GRI: Global Reporting Initiative

GMO : Genetically Modified Organism

GURT: Genetic Use Restriction Technologies

HQE : Haute Qualité Environnementale

ICPE: Installations Classées Pour l'Environnement

IDDRI : Institut du Développement Durable et des Relations Internationales

IFB : Institut Français de la Biodiversité

INRA : Institut National de la Recherche Agronomique

INSEE : Institut National de la Statistique et des Etudes Economiques

ISO: International Organization for Standardization

IUCN : International Union for Conservation of Nature

MAB: ManAndBiosphere program (UNESCO)

MEA: Millennium Ecosystem Assessment

MEEDDAT : Ministère de l'Ecologie, de l'Energie, du Développement Durable et de l'Aménagement du Territoire.

MetaHIT: Metagenomics of the Human Intestinal Tract

MnHn : Muséum national d'Histoire naturelle

MSC : Marine Stewardship Council

OECD: Organisation for Economic Co-operation and Development

PEFC : Pan European Forest Certification

PGI : Protected Geographical Indication

QHSE : Qualité Hygiène Sécurité Environnement

REACH : enRegistrement, Evaluation et Autorisation des substances Chimiques

SARL: Société à Responsabilité Limitée

SDAGE : Schéma Directeur d'Aménagement et de Gestion des Eaux

UNEP: United Nations Environment Programme

UNESCO: United Nations Educational, Scientific and Cultural Organization

WWF: World Wildlife Fund

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PUBLISHER: FONDATION POUR LA RECHERCHE SUR LA BIODIVERSITÉ – *ORÉE*

Officially launched by the Ministers of Ecology and Research in February 2008, the FONDATION POUR LA RECHERCHE SUR LA BIODIVERSITE (FRB) brings together public research institutions, environmental organisations and managers of biological resources, along with businesses, in pursuit of a single goal: to meet the challenges posed by biodiversity. It merges two existing organisations, the Institut français de la biodiversité and the Bureau des ressources génétiques. In accordance with the guidelines of the National Strategy for Biodiversity adopted by France in 2005, the FRB's mission is to promote at national, European Community and international levels the development, support and facilitation of research on biodiversity across the fields of biology, socio-economic studies and law, along with related training, consciousness-raising and dissemination of results. It focuses on four activities:

- Gathering and analysing information about research on biodiversity and its methods and applications, in France and internationally,
- Improving co-ordination among researchers within France and with colleagues in Europe and elsewhere,
- Encouraging the dissemination and assisting with the use of research results and scientific expertise, particularly by economic agents, governments and biodiversity managers,
- Establishing a sustainable partnership between government departments and businesses, non-profit organisations and managers in the field of research on biodiversity, conservation and the management of genetic resources.

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Orée, founded in 1992, is an organisation whose members have come together from different fields to hold shared discussions and test concrete solutions for integrated environmental management throughout France. Its name was taken from a statement by Orée's founding President: "Quand l'économie avance, l'orée du bois recule" ("Whenever the economy progresses, the edge of the forest retreats"). This quotation speaks to the organisation's commitment to proposing solutions to the consequences of indiscriminate economic growth at nature's expense, with the goal of bringing economy and ecology into balance. The organisation's essence is expressed in its seven priority topics: the eco-design of products and services; business and biodiversity; environmental risk; raising environmental awareness; ecological business management; local consultation; and environmental expertise. For the last 16 years *Orée* has been developing an ethos of consultation and public/private partnership to assist its members in making the practical changes essential for taking account of the environment. It forms a unique space in which information about experiences and best practices can be exchanged, promoting dialogue among businesses, local governments, institutions, scientists and non-profit organisations. It is a creative locus for the development of concrete methods to help in the integration of the environment. From the outset *Orée* has worked to break ground for emerging environmental concerns. It has published a number of guides: a guide to the environmental management of business parks, a guide to local consultation, a guide to risk, a guide to the environmental performance of transport and logistical systems, a guide to the environment with respect to client-supplier relations, and the implementation of an industrial ecology approach to a business park. *Orée* also maintains regular contact with and communicates its perspective to institutions, government agencies and professional associations. As such, its voice has been heard on issues of eco-design, expertise and governance, industrial ecology and biodiversity at the Grenelle de l'Environnement. It is a source of expertise, offering its associates a network of consultants for purposes of auditing or pre-diagnosis. Lastly, *Orée* is a major source of information on environmental management. It enables its associates to benefit from privileged access to information while quickly and efficiently promoting environmental action to targeted contacts via a weekly newsletter, a monthly environmental press review, a legal news alert and access to a members-only space.

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A word from the President of Natureparif

Natureparif, the regional agency for nature and biodiversity in the Ile-de-France, was formed at the initiative of the Conseil régional in early 2008, as part of the regional strategy for biodiversity. The three primary goals of this strategy are to collect all the data on biodiversity within the Ile-de-France, to encourage the sharing of both information and experiences which aim at preserving biodiversity, and to offer educational programmes to our citizens, designed to raise their awareness of the issues at stake.

Natureparif is the most recent of the regional offices concerned with environmental issues. Its task is to communicate information and recommendations to the general public, in the same way that Airparif does for air quality, Ordif for waste disposal and Bruitparif for noise pollution.

As a Law of 1901 association, Natureparif plans to involve everyone actively in the preservation of biodiversity. They may simply be seeking a fuller understanding of biodiversity, they may be professionally concerned with protecting it, or the work they do may impact it; they may be scientists, conservation groups, businesses, developers or local authorities - whoever they are, they have a role in the work of Natureparif.

Natureparif's contribution to this new guide is in tune with this goal: the region is actively pursuing the "Integration of biodiversity into business strategies". For many people, the Ile-de-France is synonymous with densely populated towns and cities, airports and motorways. This overlooks the fact that 80% of the region is made up of green spaces and farmland, and that it has a rich natural heritage to be preserved by all and for all. The blueprint for the Ile-de-France region, adopted in 2007, and the regional strategy for biodiversity, passed in June 2007, both signal this ongoing commitment. Businesses too have their role to play.

In the methodology and the self-assessments it presents, this guide demonstrates that there are many businesses, varying widely in size and industry sector, which benefit from biodiversity and can contribute to its preservation. Beyond our partnership in the publication of this work, you can be assured that Natureparif will strive to disseminate - regionally, nationally and across Europe - the key tools set out in this book.

Jean-Vincent PLACE

Veolia Environnement is the world leader in environmental services. With a presence on all five continents and over 319,000 employees, it provides tailored solutions to industry and local government in four complementary areas: water management, waste management, energy management and passenger transport management.

The Carrefour group, number one retailer in Europe and number two world-wide, features four main types of food shop in 30 countries: hypermarkets, supermarkets, discount and convenience stores. It has more than 490,000 employees, and every year 3 billion customers pass through the checkouts of nearly 15,000 shops.

A subsidiary of the Group Italcementi, GSM produces aggregates, construction materials essential for the building of homes and infrastructure. The natural resources it exploits in a spirit of respect for the environment come from about a hundred quarries and other land and marine sites, in France and Belgium.

LVMH Moët Hennessy Louis Vuitton, a world leader in the luxury trade, is active in five sectors: wines and liquors, fashion and leather goods, perfume and cosmetics, watches and jewellery, and selective retailing, with a unique portfolio of more than 60 world-famous brands.

Nature & Découvertes was one of the first companies in France to make a commitment to the environment. This commitment is expressed in the support its Foundation has provided for the last 15 years to nature conservation associations and also in the thousands of activities the company has offered its customers in order to share its love of the natural world with them.

Certified ISO 9001, 14001 and OHSAS 18001, the law firm of Savin Martinet Associés (www.smaparis.com) practices a multidisciplinary approach and offers a range of legal services (advice, litigation, acquisition audits) especially in the fields of environmental law, polluted sites, industrial hazards, chemical safety, hygiene, health and safety, renewable energy, classified installations, etc.

Séché Environnement, a signatory of the UN Global Compact, is a major French company in the (non-radioactive) waste recycling and processing sector. Its industrial facilities enable it to offer comprehensive solutions which include all the requirements of environmental protection measures.

The Société Forestière of the Caisse des Dépôts is one of the leading private forestry operators in France. It focuses today on proposing new solutions to biodiversity conservation, particularly in its presidency of CDC Biodiversité, another subsidiary of the Caisse des Dépôts.

Yves Rocher is a grower-manufacturer and distributor of plant-based beauty products world-wide. The preservation of the environment is a priority which has underpinned all its activities for the last 50 years.

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Reconciling economic activity with biodiversity calls for a twofold initiative: encouraging businesses to take action and creating new methods for them to do so. *"Integrating biodiversity into business strategies"* is designed to meet this dual need. The research performed by the *Orée*-Institut français de la biodiversité Working Group has confirmed that biodiversity underpins the development of a great number of enterprises. Self-assessments, through the application of the *Business and Biodiversity Interdependence Indicator*, present the self-perceptions of a range of businesses and local governments relative to their interdependence with biodiversity. These self-perceptions underline the fact that the economy as a whole interacts directly and indirectly with living systems.

It is commonly supposed that biodiversity can be sustained by putting a price on it. In reality this is a counterproductive approach. The method proposed by the "Bilan Carbone" measures the amount of greenhouse gases emitted by all the physical processes required to sustain specific human activities or organisations, insofar as their boundaries are clearly definable. It does not, and is not designed to take account of the interactions between living systems and businesses. The *Biodiversity Accountability Framework* is thus proposed as an alternative, interdisciplinary method, structured to highlight and delimit the responsibility of organisations to ecosystems.

For its implementation to be profitable, and for companies to adopt this approach in a thoroughgoing way, it requires rethinking the present modes of regulation. The Millennium Ecosystem Assessment (2005) underscored the urgency of the situation, as did the results of the first phase of the TEEB study (2008) bearing on the costs of inaction relative to biodiversity. This guide aims to shorten the time needed for the discussions that will lead to the reintegration of economic activity into biodiversity. When the goal is the co-viability of biodiversity and businesses, the key question becomes: how can profits be used to diversify living systems, and how can biodiversity become a source of increased profits?

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