Hervé Brédif | Laurent Simon

BIODIVERSITY AND STRATEGY

Subtle equilibriums

éditions Quæ

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Hervé Brédif and Laurent Simon

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‘Planners have no enemies in their organisational vision of the world. They can order everything rationally and inevitably achieve their goals by choosing suitable, even drastic, means. But means, especially human means, don’t bend easily to objectives; ultimately—fortunately—they stand in the way of rational prescription. Strategists, however, know they must consider the fact that the enemy may react to their actions. Hence, they choose their objective with a mind to the means at hand, in other words, the resources available and existing constraints. Then, pragmatically, they seek to mitigate constraints by cooperating with the resources at hand as efficiently as possible. In other words, while commanders only see their plan, strategists rely on the reality on the field.’

Michel Crozier, 1995

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Biodiversity: A multifaceted notion

For over thirty years, scientists, experts and agencies in charge of environmental issues have provided a plethora of definitions for the concept of biodiversity.
The term 'biodiversity' was first used in 1986 during a conference entitled *The National Forum on BioDiversity*, held in Washington under the aegis of the US National Academy of Sciences and the Smithsonian Institution[1]. The proceedings of this conference, coordinated by Edward O. Wilson and Frances M. Peter, were published in 1988 with the title *Biodiversity*, and with the well-known following definition:

> 'Biological diversity, or biodiversity means the variety and variability among all living organisms. This includes, intra-species and inter-population genetic variability, the variability of species and their life form, the diversity of associated species complexes and their interactions, and the diversity of the ecological processes they influence or in which they are involved [known as ecosystem diversity].'

In and of itself, this definition is nothing new. Several authors (Bergandi and Blandin, 2012; Blandin, 2019; Le Guyader, 2008; Barbault, 2018[2])

1. The term was coined in 1985 by Walter G. Rosen while preparing for the conference.

2. 'It is a well-known and long-standing fact that life manifests itself in very diverse forms. […] naturalists, palaeontologists, systematists, then ecologists and geneticists have never ceased to point out the diversity of life forms, i.e. the wealth of species both living and extinct, the genetic variability within populations of the same species, the diversity of the ecological functions they perform and of the ecosystems they constitute.' (Barbault, 'Biodiversité', *Encyclopedia Universalis*, 2018).

have highlighted that scientific research has shown a long-standing interest in gene, species and ecosystem diversity. Such a definition shows biodiversity as a characteristic, a property of living beings. However, as highlighted by Virginie Maris (2010), it does introduce a hitherto overlooked dimension:

> 'In the past, except for a few specialists, biological diversity would mostly refer to species diversity whereas biodiversity refers to the diversity of living organisms at every level of organisation.'

How, then, do we explain how a term (the result of a simple lexical contraction) has become a mandatory point of reference for international policies and a key topic of major international conferences in just a few years? There are several reasons for this, which point to the concept being open to other dimensions and registers, resulting in the term's polysemy and, at times, ambiguity.

The first reason[3] is the progressive substitution of the term 'nature' by that of 'biodiversity', both in international policy-making organisations and in the scientific and non-profit sectors. The concept of 'nature' itself had become problematic: the polysemy of the term and the 'philosophical fog' (Ducarme, 2019) around it undoubtedly fostered its discredit. The debates within the International Union for Conservation of Nature (IUCN) and the environmental movement itself, between the protectionist rationale (which aims to maintain a 'wild' nature, independent of humans, as defended by John Muir in the United States, for example) and the conversationalist rationale (as per Gifford Pinchot in particular, what must be preserved above all are resources, without necessarily excluding all human activity), have highlighted the divergences arising from the concept of 'nature'. The term 'nature protection', fraught with cultural preferences, impossible to define accurately and overly vulnerable to conflict when implemented (Rossi, 2000), will gradually be replaced by 'biodiversity protection'. Biodiversity paves the way to a more scientific approach and rigorous management based on metrics. But from then on, biodiversity is no longer the property of ecological systems. It tends to become an entity in its own right, forever dissociated from human societies. For Gilles Bœuf, biodiversity is the 'living fraction of nature'.

3. A considerable body of research (Aubertin and Vivien, 1998; Boeuf, 2014; Larrère and Larrère, 2018), to which we refer, has analysed the semantic shifts in the term biodiversity.

The second reason is that, simultaneously, the body of scientific research published between the 1970s and the 1990s, by highlighting the role of disturbances in the dynamics of ecological systems, calls into question the idea of a natural equilibrium underpinning protected area zoning policies. This is particularly true of Steward Pickett and Peter White's book (1985), *The Ecology of Natural Disturbance and Patch Dynamics*. With the boom in landscape ecology (Naveh and Lieberman, 1984; Forman and Godron, 1986), a new perspective emerged through the acknowledged role of spatial heterogeneity in maintaining the diversity of ecosystems and populations. However, as Paul Arnould (2006) pointed out, 'considering landscape biodiversity or that of the major biomes that structure the biosphere integrates a territorial and cultural dimension', which is inconceivable without including the human societies behind such landscape management. Hence, nature confined to parks and reservations is replaced by biodiversity that includes historical and social parameters. It can thus be envisaged as a resource for which the question of appropriation, use, and access arises. This was illustrated in the early 1990s by the debate around the common of 'the common heritage of humanity', which, at the Rio Conference in 1992, pitted the countries of the Global North against those of the Global South on the central issue of ownership. This entity, which integrates humankind, soon expanded to become a widely shared political object with considerable media coverage, the third reason for its remarkable popularity. As Virginie Maris (2010) highlighted, this is a new transformation:

> 'Moreover, the term biodiversity suggests not only diversity itself but also the crisis it is undergoing. Biodiversity is not a property of the world around us over which we have no influence; it is a challenge we face.'

The concept, hence, shifts away from its scientific foundations (Le Guyader, 2008) to include all the dimensions of the living realm. 'Living fabric of the planet' according to Robert Barbault, it also opens up to the diversity of cultural forms viewed by Arne Næss, philosopher and pioneer of deep ecology, as 'a part of the wealth and diversity of life forms on Earth'. This is a long way from the scientific approach that initially prevailed and far from having erased the ambiguities for which nature has been criticised. As Catherine Aubertin, Valérie Boisvert and Franck-Dominique Vivien (1998) have pointed out, 'we've shifted from the purely scientific questions raised by evolutionary theories to geopolitical and industrial challenges'. Nature as biodiversity has entered the market

and the political realm. Its definition varies depending on the author and the challenges at stake. No fewer than eighty definitions were identified between 1985 and 1995 (DeLong, 1996).

In the final analysis, far from overcoming the imprecise character of the term 'nature', the term 'biodiversity' has merely shifted the ambiguity. Critics were quick to point to the polysemic nature of the concept and ensuing pitfalls: 'bring and buy sale' (Lévêque, 2008), 'fuzzy concept' (Le Guyader, 2008), 'technocratic substitute for nature' (Blandin, 2013), etc. There is no lack of expressions to highlight the imprecision of the notion. However, the same researchers who criticised the notion use it. For example, in 1995, Jacques Blondel—President of the scientific committee of the French Institute for Biodiversity from 2000 to 2005—regarded the term biodiversity as an 'empty shell which everyone fills as they wish', but he published a book in 1995 entitled *Biodiversité, un nouveau récit à écrire*. However, this is hardly surprising and only illustrates 'the impressive power of multiplication [of the notion] and the positive and dynamic charges associated with the assembled ideas of life and diversity [which] turn it into an unassailable term' (Arnould, 2006). The result is a considerable amount of confusion, including in some peer-reviewed publications in renowned scientific journals:

> 'This is why one can frequently come across scientific articles that mention the term "biodiversity" in the title or keywords, whereas the article itself will focus, for instance, on a biological process or an ecosystem service and not on the diversity of life forms within an ecosystem.' (Gosselin and Gosselin, 2010)

We neither claim nor wish to decide between all the possible acceptations. Instead, we feel that integrating the plurality of meanings is a means to understand better the issues and debates that permeate the stakeholders of biodiversity protection. Behind each definition, there is a conception, a project, and sometimes there are interests. How could it be otherwise when key international texts and their national and regional versions convey these ambiguities, reflecting the compromises between the various stakeholders?

Strategy aims for the efficiency of difficult action

Public action has been making great use of strategy lately, from global warming to the erosion of biodiversity and, more recently, the COVID-19 pandemic. It is a global phenomenon. Academics, the media, experts of

all types and politicians endlessly comment on government strategies, while state agencies, high scientific councils and expert forums produce countless 'strategic recommendations'. Overusing the term leads to trivialisation, to the point of losing sight of its meaning. As a result, nobody really takes the trouble to define the term and consider whether it is being used properly.

Yet, there is a substantial body of work on the subject. It is worth recalling some of the basic teachings of this literature.

Derived from military vocabulary, the concept of strategy refers explicitly to war. The term strategist comes from the Greek *stratos*, 'army', 'crowd', 'troop' and *agein* 'to lead' and refers to the person who leads an army. The term strategy, therefore, implies a confrontation between opposite sides. It refers to action and, as a first approach to a definition beyond the military realm, may be defined as 'the art of achieving one's goals'.

Not just any action, however. Introduced in Sun Tzu's *The Art of War* (sixth century BC), strategy was initially concerned with the survival of the State and, specifically, how to guarantee its longevity in a world of rivalry and conflict. Because war can be waged in many ways, the term is now widely applied to the economic field: to avoid being absorbed by the competition or being eventually outperformed in their area of business, corporations and companies have a vested interest in developing strategies of their own. In every case, strategy is concerned with issues of the utmost importance, which are vital to the survival of the entity in question.

Specifically, strategy concerns complex action. Anything that does not pose a real problem, routine issues, current affairs or traditional controlled problem management falls outside the scope of strategy. Strategy implies that reality puts up a certain amount of resistance: a relatively strong degree of uncertainty as to the possibility of achieving the desired goal; a rather stubborn and uncooperative context; the significant probability of headwinds, paradoxical and unexpected effects; a greater or lesser risk that a set of factors, dimensions and stakeholders might combine in such a way—whether intentionally or fortuitously—as to thwart the end in view significantly. Hence, strategy fundamentally differs from planning, as the sociologist Michel Crozier pointed out in the quote at the beginning of this book. Planning applies to situations where reality is accommodating: a flexible reality that accepts bending to the planner's will to conform to his intentions and projects. In short, it is a more or less cooperative reality. The first lesson, hence, is the necessity of ascertaining

to which extent the 'strategy' claimed by a given entity is really deserving of the term and is not, in fact, a mere 'action plan' masquerading as strategy. Admittedly, however, if public action makes so much use of the notion nowadays, it is because the situation is more or less clearly viewed as uncomfortable, and the outcome is far from certain.

The purpose of strategy is not to shamelessly fleece the opponent, let alone obliterate them, as one might wrongly believe. Rather, it is to secure a significant profit or, better still, a substantial and durable advantage. Moreover, it is not a matter of setting grandiose goals and leaving it to the stewards to define the means of achieving them; in a strategic approach deserving of the name, the means are not mere variables in the service of the ends. The means should be considered together with the ends: the utmost economy of means for maximum relevance and efficiency. Hence, the critical issue: rather than overdoing things, it is preferable to identify the levers of change that will trigger the transformation processes, which in turn will bring the expected victory or desired improvement. Second key lesson: avoid grandiloquent commitments, which all too often hide a lack of resources or, worse, a certain lack of reflection when it comes to identifying the ways and means sufficient and necessary to reach stated goals.

Finally, Western and Eastern strategy treatises agree on one essential step: taking the time to meticulously examine the terrain, the notion of terrain being understood broadly to cover all the parameters and conditions likely to affect the configuration of the issue encountered. Close scrutiny of the terrain is critical to avoiding strategic errors resulting from overlooking dimensions or aspects that are, sooner or later, bound to thwart the aims pursued. More importantly, it is the only possible way to define realistic ends and the judicious and proportionate ways to reach them. Hence, the third lesson: the strategic diagnosis phase is essential to ensure that no significant aspect or component of the issue has been overlooked.

In other words, science and strategy should be clearly distinguished. Science is concerned with knowledge: its purpose is to increase our understanding of phenomena. Conversely, strategies are concerned with action: they aim to increase the effectiveness of action pertaining to significant problems or issues.

Strangely enough, contemporary rhetoric tends to obscure this distinction. Faced with a number major economic crises, we are told that the solution simply consists in reconciling scientific truth with political will. This amounts to an odd confusion between the register of knowledge

and the register of action—as if scientific knowledge could automatically lead to relevant and practical action. While this may be acceptable for areas and fields where scientific expertise can directly inspire political decision-making, this fallacious understanding of action has no chance of success in facing complex issues that involve intricate and multiple parameters, stakes and stakeholders with diverging logics and interests. Facing such situations, it is worth remembering that strategy is precisely 'the art of achieving one's goals' under challenging contexts.

INTRODUCTION

Unlike climate change, biodiversity loss is not a major controversial issue. In fact, specialists agree on three key points: because of the roles it plays and the goods it produces, biodiversity is crucial to the future of humankind; natural environments have been significantly degraded by human activity for decades, and the many threats looming on the horizon mean that the diversity of life forms is in danger of collapsing brutally and uncontrollably; only awareness and a thorough review of the relationship between human activities and natural systems can avert the predicted catastrophe, for species, natural environments and humans alike.

Unfortunately, notwithstanding repeated appeals from the highest scientific and moral authorities, the revolution in awareness and behaviour is slow in coming. Political agendas are dominated by economic, social, security and geopolitical emergencies. Climate change continues to take precedence over all environmental issues. In a society of screens that is now predominantly urban, the connection with nature has significantly weakened. As a result, those who are most concerned about the future of life on Earth regularly give in to despair, and disillusioned assertions proliferate: 'Nobody cares about biodiversity, indifference is the rule'; 'Triumphant capitalism doesn't care; more than ever, economic interests are running the show and lobbies rule the roost'; 'Politicians are unable to free themselves from the dictatorship of the short term, electoral deadlines dictate the priorities of the moment'; 'Materialism and individualism are the scourges of our age, and the common good pays the price every day'. This general picture—easy to paint as it is relayed through thousands of different channels—nevertheless omits one key aspect. The general public is unaware of it, and many people who work in the field to protect nature and living things are only vaguely aware of it: for several decades now, public policies on biodiversity, in France as in the rest of the world,

have been inspired primarily by an official strategic approach. Gradually developed in the wake of international meetings on species protection and nature conservation and consolidated by several international conventions, including the Convention on Biological Diversity promoted by the Earth Summit in Rio de Janeiro in 1992, it has steadily gained in strength, precision and scope. Building on this long history and continuity, in 2010, the international community developed a 'strategic plan' featuring twenty primary targets to stem the erosion of biodiversity. The fact is that, despite large-scale studies and international expert reports, numerous intergovernmental meetings and the resolve to achieve results through multilateral negotiations, and despite the significant progress made on a few indicators, expectations about the future of biodiversity have never been so bleak.

Strangely, strategic thinking at work in the case of biodiversity hardly raises any questions. Books and papers on the crisis of the living world, the science of biodiversity, and the philosophy or governance of nature abound, yet minimal research deals directly with biodiversity strategy or strategies. Our book aims to address this gap.

Traditionally defined as 'the art of achieving one's goals', strategy implies identifying the conditions and means of efficient and relevant action; as necessary as they may be, scientific inventory or diagnosis are insufficient to build a strategic approach deserving of the name. More specifically, we base our work on a hypothesis that can be formulated simply: could the difficulties and failures encountered in the fight against biodiversity loss stem from an incomplete way of framing the problem, which would affect how we attempt to solve it? In other words, are the foundations of the strategic approach governing the conception of action to fight biodiversity loss being challenged? Not that we should reject out of hand the usual explanations offered to explain the lack of attention paid to biodiversity, in the view of many observers. Not that we mean to call into question the wealth of thoughts, experiences and knowledge patiently accumulated regarding the erosion of living things and how to respond to it. However, we will be considering whether certain aspects, dimensions or relationships have been insufficiently considered in how we have tried to curb the phenomenon. By bringing these neglected areas or blind spots back into the equation, we will see how they can be used to draw up a more comprehensive strategic diagnosis, a diagnosis likely to make pro-biodiversity action significantly more effective by allowing it to rest on stronger and more promising foundations.

This book comprises three sections. The first section explains the foundations of the official strategic approach to fight biodiversity loss. We will see that the current diagnosis is based on three key ideas and that, over time, global action has been built around five major pillars or directions. However, these pillars or directions are not fully recognised, as they are driven by distinct communities of experts and players.

The overall structure of official strategic action raises few objections. However, the practical arrangements on which it is based give rise to a host of criticisms which are not entirely reflected in the diagnosis behind international negotiations. The second section of this book sets out to identify and formulate such criticisms and limitations by focusing on those expressed by researchers and recognised experts in their field. The resulting overview is not intended to be exhaustive. The ideas and arguments presented will probably be familiar to specialists. Still, they are all the more interesting as they are part of an overall picture which, as far as we know, has never been produced before.

Through comparison of previous analyses and results, the book's third section shows that the official diagnosis of the state of biodiversity is surprisingly simplistic and skewed. A cross-disciplinary examination of the criticisms and limitations formulated by various specialists brings to light neglected and converging dimensions of the problem; reintegrating them enables us to develop a substantially updated strategic diagnosis that resonates with the nature of the issue at hand. The point, therefore, is not so much to propose turnkey strategies—the various players involved in biodiversity are ideally placed to develop these with all the necessary contextual finesse—as to insist on a few promising levers for transformation.

THE FOUNDATIONS OF OFFICIAL STRATEGIC THINKING

It would be impossible to analyse the results and limitations of actions undertaken over the decades to promote biodiversity without looking at the players and context behind these actions.

A long-standing community of thinking

A particular community of stakeholders was behind this concern. This community placed the issue on the international agenda, which has consequently shaped how the problem has been approached[4]. There are a few significant texts that provide insight into the strategic thinking of these players. These include the 1948 founding text of the International Union for Conservation of Nature (IUCN), the 1980 World Conservation Strategy[5] drawn up by IUCN[6] and the United Nations Environment Programme (UNEP), the 1992 Rio Convention on Biological Diversity, the 2005 Millennium Ecosystem Assessment, the 2010 Aichi Targets and the 2019 report of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES).

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4. The movement in defence of nature began at the end of the nineteenth century. However, we will only mention post-1945 texts which we feel are the most relevant to understanding current strategies. For a full analysis, see Bergandi and Blandin (2012).

5. In the 1990s, IUCN would publish several fundamental documents: 'Conserving the world's biological diversity' (McNeely *et al.*) in 1990, 'Sauver la planète' (Saving the planet) in 1991, a text updating the 1980 strategy and in 1992, a document called 'Global biodiversity strategy'.

6. The change of acronym (IUPN became IUCN in 1956) marked a significant shift in the organisation's theses in favour of a conservationist approach less focused on strong protection (see Bergandi and Blandin, 2012).

Hence, there are but a few such central texts of strategic import[7]. Despite certain shifts, which we will discuss later, they demonstrate a veritable continuity of thought centred around a few major institutions. Such enduring continuity—spanning close to seventy years now—makes it possible to identify and analyse the building blocks of the strategies adopted and their invariants, i.e. how problems are posed and solutions put forward. The import of these texts is such that they were adapted at the European level (European Union's biodiversity strategy in 1991), national level (first national biodiversity 2004–2010 in France), and local level (such as the 2020–2030 biodiversity strategy in the Ile-de-France region). It is quite impressive to observe the extent to which local and national strategies were modelled on global strategies, reproducing their approach almost identically. The following analysis centres on this corpus of texts and the conditions in which they were produced.

The decisive role of top international organisations

The biodiversity community gravitates around non-governmental organisations (NGOs) and international bodies. It relies heavily on the participation, knowledge and contributions of scientists who predominantly hail from the life sciences.

The creation of the IUPN in 1948 was a major first step[8]. Patrick Blandin writes that it marked the birth of a 'Nature International'. The founding text would be signed by governments (initially eighteen), as well as by seven major international organisations (starting with UNESCO, the United Nations Educational, Scientific and Cultural Organization) and many national bodies from all over the world. The clearly stated goal was the 'preservation of the living world', considered to be the responsibility of States, and even more so of the international community, with IUPN setting itself the goal of developing international agreements and the signature of a 'world convention for the protection of nature'.

From the outset, IUCN relied on international bodies, in particular, UNESCO and then progressively on other UN-related bodies, such

7. Between 1950 and 2010, however, other conventions, reports, treaties and action programmes complemented these key texts without attaining equal 'strategic' value.

8. Our purpose is not to proceed to an exhaustive analysis of the history of the relationship between society and biodiversity. For further information on this subject, please refer to Patrick Blandin's book, *Biodiversité. L'avenir du vivant* (2011).

as the Food Administration Organization (FAO), the World Health Organization (WHO) and UNEP. UNESCO and IUCN would jointly organise major conferences to set the pace for awareness-building. This was the case of the First World Congress on National Parks in 1962, in Seattle, or the Paris Conference in 1968 that would give birth to the programme Man and the Biosphere (MAB). While the Seattle Congress was still primarily dominated by conservation specialists, the 1968 Conference opened to a broader range of stakeholders (with the growing influence of international bodies and major NGOs) through the participation of the FAO and the WHO. The 1972 United Nations Conference on the Human Environment in Stockholm, essentially organised and facilitated by IUCN members, gave birth to a new international instrument, the UNEP. It was also the IUCN, together with the World Wide Fund for Nature (WWF), UNESCO and FAO, that drew up the World Conservation Strategy in 1980[9], defining the conservation goals and the measures to be adopted internationally and nationally. The role of States is fundamental within UN-related bodies. Indeed, their autonomy, budget, staff and delegated powers hinge on the resources member states allocate (Orsini, 2017).

Alongside the IUCN, associated with international conferences and congresses, as we have just mentioned, other environmental NGOs have also become critical actors in biodiversity protection policies (Chartier, 2015). They are active worldwide and play a key role in shaping the policies implemented. This is the case of the WWF, with its many campaigns to protect specific threatened species (tigers, whales, rhinoceroses and elephants) that have led to international (or national) texts, such as the 1982 moratorium on commercial whaling. The same is true of the numerous Greenpeace campaigns against deforestation in the Amazon (Chartier, 2005). Not only did they raise international public awareness (mostly in northern countries), but they also helped place the issue of the certification of commercial timber on the international agenda, in particular by promoting the Forest Stewardship Council (FSC) certification (Arnould, 1999), ideated by Greenpeace and WWF experts, among others. These international NGOs also started managing protected sites; as a result, they are often at the root of recommendations on managing protected areas. Consequently, the WWF became a 'key player in the conservation policies of many developing countries'. Moreover, international NGOs

9. This was the first text officially mentioning the need to preserve 'genetic diversity'.

play an advisory role during big conferences and some—the WWF especially—have partnered with global corporations. Given their scale and the network of experts they federate, they play a considerable assessment and expertise role, which they can leverage in the international legal arena.

These international players remain deeply rooted in the rationale that prevailed when the IUPN was founded, namely the international development of agreements and conventions. As a result, such agreements proliferated, and no less than seven hundred and thirty regional or multilateral agreements on the environment had been signed by 2015 (Morin and Orsini, 2015).

The 1992 United Nations Conference on Environment and Development—better known as the Rio Summit—marked the advent of the term biodiversity on the international scene, reflecting the decisive influence achieved by the community of international players. It introduced a 'philosophy' of action and governance mechanisms, consolidating the influence of a few 'big' players. Once again, the preparation of the summit was a joint effort of international bodies (UNEP, IUCN and WWF), supported by an American institute, the World Resources Institute (WRI[10]). After bitter discussions, this summit, which remains the largest gathering of world leaders, adopted a Convention on Biological Diversity whose governing body is the Conference of Parties (COP), with representatives of every government that ratified the text. At this point, biodiversity explicitly became an international concern, debated and discussed internationally by global players. It instituted an international calendar of key thematic meetings every second year. The international agenda, therefore, sets the pace and guides biodiversity policies under the aegis of the major global players.

However, these global groups have opened up to non-governmental players in the last twenty years. Long confined to the role of mere observers, over the last decade, these players have become fully-fledged partners in the negotiation process. Yet they form such a disparate group that it is difficult to consider them as a separate entity[11].

10. The WRI is an American think tank founded in 1982.

11. 'Agenda 21 of the United Nations identifies nine major groups of non-governmental players: women, children and youth, indigenous people and their communities, NGOs, local authorities, workers and their trade unions, business and industry, the scientific and technological community and farmers.' (Morin and Orsini, 2015)

At the same time, the difficulties encountered locally in several countries in getting protection statutes adopted have raised the concern that local stakeholders should be involved in the measures put in place. Thus, most international texts in recent decades refer to participation as an indispensable tool for the acceptability and sustainability of biodiversity policies. As a result, a significant evolution occurred recently in the conception of protected areas, with some designed to ensure both protection and local development. Nonetheless, this emphasis on participation has hardly affected the respective influence of the various stakeholders. Participation is still widely designed to secure acceptance of the highest-level decisions.

Biologists and economists watching over biodiversity

The international players relied on scientific research at a global level[12].

From the 1960s onwards, committed scientists and experts would sound the alarm. Some books have had a significant impact worldwide and primarily contributed to global awareness. For example, biologist Rachel Carson's *Silent Spring*, published in 1962, marked the beginning of the *new environmentalism* movement in the United States; in France, ornithologist Jean Dorst's book *Avant que nature meure*, published in 1965; biologist Paul R. Ehrlich's *The Population Bomb* in 1968; biologist Edward O. Wilson's 1992 publication *The Diversity of Life* and, more recently, in 2005, biologist Jared Diamond's bestseller *Collapse: How Societies Choose to Fail or Succeed*.

Moreover, from the outset, the scientific world was closely involved in the bodies and discussions preparing critical international meetings. At first, it was broadly represented in large institutions, NGOs and intergovernmental organisations, with members either on their scientific council, expert panels or management boards. Up to the 1990s, all the IUCN presidents (the first female president was elected in 1996) were scientists. They, or at least some of them, were keen to open up the field of science

12. Scientists have long been influential in supporting the nature protection movement. Scientists were key speakers when the IUPN was founded and at the International Technical Conference in Lake Success (1949). In 1954, Professor Roger Heim, Director of the Museum of Natural History and member of the French Academy of Sciences, was elected President of the IUPN. Under his presidency, the IUPN became an organisation strongly 'rooted in science', an approach that would be confirmed by the presidents who followed: the Swiss biologist Jean Baer (1958-1963) and the French physician and ecologist François Bourlière (1963-1966).

to political decision-making, consequently falling within the scope of expertise, 'understood in the broad sense as the integration of scientific knowledge into a political decision-making process' (Granjou, 2003).

These 'scientist experts', essentially from the biological sciences, were the first to contribute to the awareness of the damage caused by societies to species and ecosystems. The International Council of Scientific Unions and the International Union of Biological Sciences were among the seven international organisations that signed the IUPN constitution in 1948. Most scientists who hold high-level positions in international bodies come from these disciplines. In light of what they consider an absolute emergency, these biologists, under the leadership of Michael Soulé, created a new discipline, 'conservation biology', which aims to be a science of action focused both on the assessment of biodiversity losses and on the urgent measures to be taken to curb or halt the process. These scientists have founded internationally recognised journals, such as *Conservation Biology*, which offer a comprehensive set of analyses around the central concept of biodiversity. These analyses have led their authors to diagnose the situation (essentially regarding ecology and biology) and considerations on how to curb the crisis. Hence, many international research programmes have emerged to assess the state of biodiversity. The first significant initiative in this area was launched by UNEP and resulted in the Global Biodiversity Assessment of 1995, the creation of an international observatory, the Group on Earth Observations Biodiversity Observation Network which regularly draws up the Global Environment Outlook; the funding of extensive research programmes such as DIVERSITAS started in 1991 as the brainchild of a partnership between UNESCO and the International Council for Science (ICSU).

Two key phases should be highlighted regarding this research effort. The first one was marked by the kick-off in 2001, under the aegis of the United Nations, of an ambitious programme: the Millennium Ecosystem Assessment (MEA). The MEA's goal is to identify the state of ecosystems and the social challenges linked to these ecosystems. The project's Steering Committee comprises thirty-three members, including fifteen scientists, a dozen representatives of international bodies and national administrations, one WRI representative, one IUCN representative and one from the private sector through the World Business Council for Sustainable Development (WBCSD). Denis Pesche (2013) has highlighted the significant role of some, primarily scientific, networks in the MEA's evaluation process. In addition to the World Bank and the representatives of

environmental international bodies and global conventions, two scientific networks would play a key role: One is concerned with *ecological economics*, bringing together ecologists, biologists and economists; the other, more directly focused on the study of ecological processes, works specifically with the UN bodies in charge of climate change. Such a composition can be partly explained by the MEA's future approach: a 'planetary' approach to the issue that focuses on the significance of ecosystems and their valuation. In fact, the MEA would be behind the circulation of the concept of 'ecosystem services' aimed at defining the social value of ecosystems. As highlighted by Pauline Teillac-Deschamps and Joanne Clavel (2012), this approach has helped attract new players around the issue of biodiversity. It also introduced nature into the realm of economic assessment. In this way, the MEA bore witness to the growing involvement of economists within the scientific community. This met with a need expressed by the life sciences: to make the issue of biodiversity visible, concrete and assessable.

> 'What you can't measure, you can't manage.' Pavan Sukhdev (economist, former banker and President of WWF International from 2017 to 2021)

The second phase was the foundation in 2012 of the IPBES, the Intergovernmental Platform on Biodiversity and Ecosystem Services, bringing together nearly a thousand experts from around the world appointed by the signatory governments. Modelled on the Intergovernmental Panel on Climate Change (IPCC) for climate, the platform's goal is 'to improve the links between knowledge and decision-making, and to identify and develop decision-support tools and methods that take into account all relevant knowledge on biodiversity and ecosystem services'[13]. The IPBES showed a willingness to move on from the work carried out by the MEA. It aimed to be more open to the social sciences, the cultural dimensions of biodiversity, and local expertise. The 2019 report broadened the debate, steering it towards a more global questioning of our development models. However, these changes remained limited in practice and were thwarted by existing habits, networks, and various forms of pressure. The very title of the platform reflects an approach which, while intended to be more open, was still focused on ecosystem services and, therefore, on a utilitarian approach centred on enhancing the value of biodiversity. The first large-scale assessment launched by the IPBES on pollinators, pollination and food production confirmed this general direction.

13. Fondation pour la recherche sur la biodiversité, http://www.fondationbiodiversite.fr

What can be learned from this broad picture?

Biodiversity issues have historically been addressed by transnational bodies (institutions and major NGOs in particular). The main thrust of government policies is developed in international institutions, specifically during big meetings.

Quite logically, these players foster a global approach to the issue, leading to global solutions. Because the biodiversity crisis is a global issue, it is widely accepted that it can only be tackled by international mobilisation, justifying the objectives of the IUPN project in 1948, which focused on preparing international agreements and signing a world convention for the protection of nature.

The key players in this approach include renowned scientists such as Julian Huxley and Roger Heim. Through their active participation in institutions and international meetings, they are its initiators and legitimisers insofar as their work confirms the scale of the issue and the urgent need for significant action. Life scientists (ecology, conservation sciences and biology) play a dominant role and were joined in the early 2000s by economists[14].

This community of thought and action, which brings together scientists, governmental experts, NGOs and private businesses, enjoys a wealth of skills, networks and a broadly shared outlook on the issue. This shared conception shapes pro-biodiversity reflections and initiatives in the long term.

The three fundamental components of the diagnosis

The international approach to biodiversity is based on three interrelated ideas.

Biodiversity, a biological reality which is external to humankind

Among the many definitions of the term biodiversity, one seems to meet with consensus, as it is often repeated: biodiversity is a property, 'The property of living systems of being distinct' (Solbrig, 1991), explored at three levels:

14. The opening to other disciplines observed in the last twenty years—including within conservation biology—integrating psychological, aesthetic and social science approaches has not led to any significant change in the weight of the prevailing disciplines so far.

– genetic diversity refers to intraspecies variations;
– species diversity is the level most commonly used;
– ecosystem diversity is concerned with the diversity of environments and habitats (in the ecological sense of the term).

However, the notion becomes more complex when clarifying that biodiversity cannot be limited to an inventory of these different levels but must consider their interactions and, more broadly, the evolutionary and functional dimensions. This approach can be found in the preamble of the major international texts, as well as in the many national and regional versions of the strategies[15] adopted and in countless other research on the subject.

And yet, in the 1980s, ethnologists, in particular, had emphasised the links between biological diversity and cultural diversity (Kohler, 2011). At the Johannesburg summit in 2002, it was mentioned that 'cultural diversity should be regarded as a powerful guarantee of biodiversity' (UNESCO, 2003) and that the diversity of varieties, species, and ecosystems results partly from co-evolution between human societies and the environments they invest. However, although they interact, the two terms 'bio' and 'cultural' are still clearly delimited.[16]

Despite these moves for a holistic view of the living world, as a general rule, the classic definition is used, which considers biodiversity as a unified reality, biological above all, external to humans, and comprising of the three levels mentioned previously. The recent IPBES (2019) report testified to this through the formula: 'Biodiversity, diversity within species, between species and between ecosystems. …'

This 'naturalist' position met a need: to provide an irrefutable and shared observation attesting to the steep decline of biological diversity, and hence

15. The term strategy, regularly used in international texts, seems confusing to us and should be used with quotation marks, as it often mistakes a strategic approach for an action plan. However, to keep the text simple, we chose to stay with the official terminology, which we will discuss extensively in the third section of this book.

16. Some authors, such as Robert Barbault (2006), see biodiversity as 'the living fabric of the planet', whereby the human species is an integral part of biodiversity, and biodiversity is an essential aspect of the human species. Yet, in the end, this statement is a petition of principle. In 2001, the same author wrote an article titled: 'Biodiversity: an ecological approach to understanding our world', which seems to highlight the difficulty, including for a leading scientist, to move beyond the biological approach to biodiversity and to consider all life forms in their entirety.

an overview that virtually no one challenges today: that of biodiversity threatened by human activities and which must consequently be protected. The result, however, is a set of dichotomies (biodiversity–society/biological–social) and even ambiguities (nature–biodiversity), which allows and fosters an approach to biodiversity from the perspective of its usefulness to societies, which is the second facet of the strategic thinking at play.

Biodiversity is essential because it is important for society

In 1948, the IUPN founding text already reflected this, 'This whole [the living world] contains the Earth's renewable natural resources, the primordial factor of all civilisation'. It is because the living world is vital that it should be protected[17]. The first international conventions (Convention for the Protection of Wild Fauna in Africa, 1900; Paris Convention for the Protection of Birds Useful for Agriculture, 1902; International Convention for the Regulation of Whaling, 1946) were already clearly utilitarian (Salles *et al.,* 2016).

The preamble to the Convention on Biological Diversity (1992) is enlightening:

> 'The Contracting Parties,
> Conscious of the intrinsic value of biological diversity and of the ecological, genetic, social, economic, scientific, educational, cultural, recreational and aesthetic values of biological diversity and its components. …'

Hence, biodiversity became an entity with an intrinsic value (which is mentioned in passing) and consequently with extrinsic values about which much should be said. Propriety became a thing, a resource, 'thus, the ambiguity "biodiversity-propriety" versus "biodiversity-entity" was in place very early on'. (Blandin, 2014).

However, the Rio Conference introduced a new register with far-reaching consequences: importance became a value.

The value of biodiversity appeared as a central theme at the conference. After stressing the importance of conservation, the focus shifted to 'sustainable use' and 'sharing the benefits derived from its exploitation'.

17. The preamble to the IUPN constitution focuses on resource conservation (following the tradition of Gifford Pinchot and conservationists), while further in the exact text, the primary goal is to protect the wild world and endangered species. From the outset, the IUPN was torn between both conceptions, and the change of acronym in 1956 sealed the predominance of the utilitarian approach.

A few years earlier (1988), biologist Edward O. Wilson's seminal work had already demonstrated the extent to which biodiversity lies at the centre of fundamental issues for the survival and well-being of human societies. Examples abound, and there seems to be a consensus that biodiversity should be preserved because it is useful, vital and therefore 'of value'. Henceforth, every subsequent document, international, national and regional strategy and action plan, has mentioned the importance of biodiversity for humankind in the preamble.

However, this notion of value is often presented in its double dimension, both instrumental (the value for societies) and intrinsic (biodiversity as an end unto itself). Although frequently reaffirmed, this last dimension is rarely clearly explained as it raises too many questions and is difficult to value in practice (Larrère and Larrère, 1997). Hence, intrinsic value became a mandatory reference for every document (Heal *et al.*, 2005), but once mentioned, it virtually disappeared from official texts. As Sandrine Maljean-Dubois pointed out (2015), in and of itself, what is intrinsic does not seem to bear any specific legal consequences.

The Millennium Ecosystem Assessment's work (2005), which we mentioned earlier, confirmed this trend by emphasising the notion of ecosystem services, which is central to the approach and strategies proposed. The study's central issue is human well-being, which is shown to be dependent on biodiversity in its essential dimensions (food, health, security, social relations and freedom of choice). Hence, utilitarianism prevails (Charvollin and Ollivier, 2017).

It paved the way for a new shift: the value of biodiversity resulting from services rendered could now be evaluated monetarily. This value has a price. Not as widely known but just as seminal, the follow-up work to the MEA produced a report known as the 'TEEB'[18] whose aim was to assess 'the benefits and costs' associated with biodiversity. The polysemy of the term value now fades in favour of its economic and financial dimensions. In advocating 'the need to place a monetary value on ecosystems and biodiversity to ensure their preservation', the conclusions of the TEEB report (2010) confirmed this shift.

18. *The Economics of Ecosystems and Biodiversity (TEEB) for National and International Policy Makers*, a global report produced from 2008 to 2010 by a study panel led by Indian economist and banker Pavan Sukhdev.

From then on, biodiversity not only had a value, but it had a price. This price can be evaluated: in 1997, Robert Costanza estimated it at $33,000 billion, a figure significantly revised in 2014 ($125,000 billion). Hence, as stated in Aichi Target 2 (2010), this price can and must incorporated into accounting systems[19]:

> 'By 2020, at the latest, biodiversity values have been integrated into national and local development and poverty reduction strategies and planning processes and are being incorporated into national accounting, as appropriate, and reporting systems.'

This overview probably deserves to be qualified and discussed. Still, we find it difficult to argue against the prevalence of this utilitarian approach to biodiversity and the successive shifts that have led to placing the economic valuation of biodiversity at the forefront of action. A degree of scientific and strategic relevance must be recognised in this approach if it is to be discussed later.

Although the monetary values placed on biodiversity may be perplexing, the fact that its degradation has adverse effects with significant costs is unquestionable. Ultimately, attempting to evaluate such a cost meets a need for information, and, once again, scientists, particularly those who work in environmental economics, were the best placed to proceed to such a valuation.

This approach seems strategically relevant in a global environment marked by the omnipotence of the market economy. The economic valuation of biodiversity has been complemented by efforts to increase knowledge and awareness of the issues at stake. It has significantly contributed to the commitment of many players, both in the world of production and political decision-making. It has also helped avoid waiting systematically for a service to disappear to realise its usefulness: economic invisibility results in biodiversity loss. It has been instrumental in mobilising significant funds for research and protecting and managing natural environments. It is behind the concrete measures we mentioned earlier, which, although vigorously debated and criticised, can appear as a compromise, the first step or the lesser evil.

It established that this usefulness, which now seems quantifiable, is threatened by human activities. This is the third aspect of dominant strategic thinking.

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19. Target # 2 of the Strategic Plan for Biodiversity 2011-2020, Nagoya, October 2010 ('Aichi Targets').

Biodiversity is significantly under threat from human activities

There is a consensus on the accelerating biodiversity crisis. All research agrees on the magnitude of species disappearance in the last decades and the decline in population numbers. Assessment of this biodiversity loss is far from complete, but our indicators today are unequivocal. Nearly 26,000 species on the 2017 IUCN Red List (over 90,000) have been classified as threatened. Of these, 5,583 were critically endangered, 8,455 endangered and 11,873 vulnerable. Two facts are of particular concern currently:

– The rate of biodiversity loss is steadily increasing[20] and prospective scenarios all point to an acceleration of the phenomenon.

– Erosion affects more than remarkable and vulnerable species and ecosystems. It concerns the entirety of non-human life forms. Research has shown that populations of common species are now experiencing accelerated decline, as evidenced by the findings of the STOC (temporal monitoring of common birds) programme on common birds in France. Rachel Carson's 'silent spring' is not far off.

This alarming and shared observation led Edward O. Wilson and other scientists to posit a sixth extinction crisis (Ceballos *et al.* 2017), which would prove much faster and more global than previous extinction waves in geological history.

The factors explaining this biodiversity crisis are well identified and seem to meet with consensus (Figure 1). They are often subsumed under the acronym HIPPO-C[21]. The loss of natural habitats comes first. It concerns essentially tropical rain forests whose surface area shrinks yearly by several million hectares, according to the FAO (equivalent to the surface area of the French forest). Still, it also affects tempered environments, as evidenced by land artificialisation in France (Kraszewski, 2019). In addition to habitat loss, there is a strong trend towards the homogenisation of environments due to the progress of mechanised agriculture, as can currently be observed in South America, particularly in Brazil. Habitat loss and environmental homogenisation go hand in hand with

20. Not only does this erosion rate take the disappearance of numerous species into account, but also the decline in the populations of many other species.

21. HIPPO-C: habitat loss, invasive species, pollution, human population, overharvesting and climate change.

the degradation of natural habitats through fragmentation (development of transport networks and energy infrastructures notably) and the effects of pollution linked to the massive use of chemical inputs. Soil and water quality inevitably affect the wealth of life in ecosystems. The boom in international travel is also reflected in the growing circulation of fauna and flora, resulting in an ever-increasing number of invasive species, some of which are responsible for the degradation of local natural habitats, particularly islands. The overexploitation of ocean and continental resources threatens the often fragile equilibrium of animal and plant populations and destroys many rich habitats (corals, rainforests, etc.). Moreover, the current and future impacts of climate change are likely to result in a significant shift in the geography of species over the coming decades.

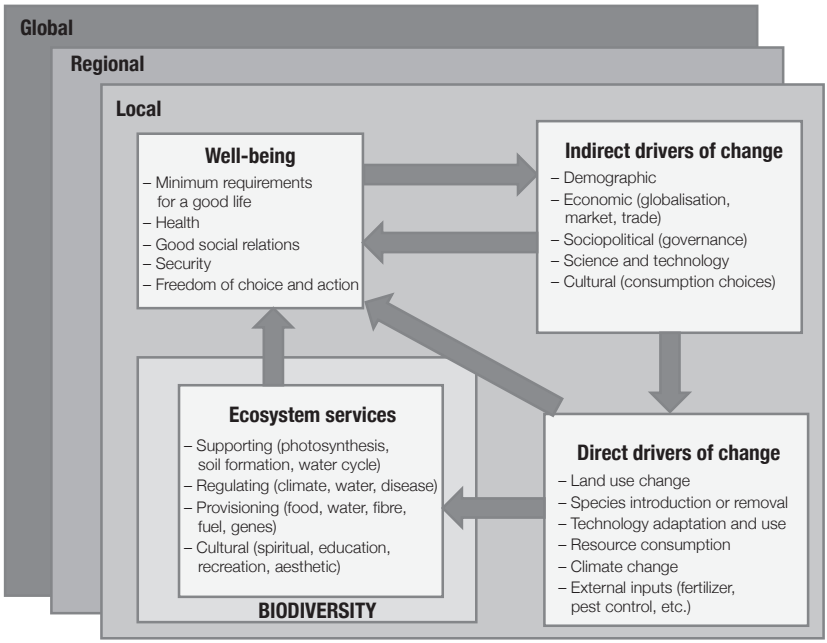

Figure 1. Millennium Ecosystem Assessment conceptual framework (based on the Millennium Ecosystem Assessment, 2005).

Ultimately, the diagnosis that has underpinned biodiversity action for decades—regardless of evolutions, openings and nuances—gravitates around three precise (Figure 2) and broadly shared ideas.

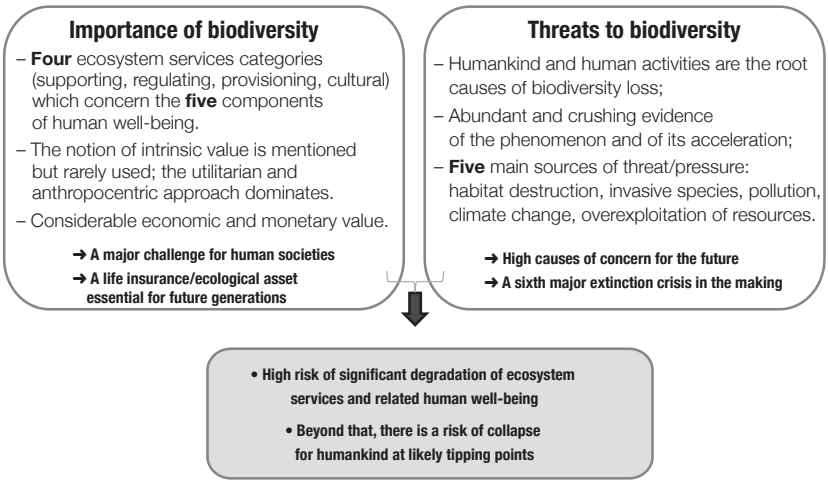

Figure 2. The fundamentals of the official diagnosis on biodiversity (based on Brédif, 2016).

The five pillars of strategic action

This diagnosis, widely shared by scientists, international organisations and many governments, is the cornerstone of policies to curb or halt biodiversity loss.

Since its implementation in 1992, the Convention on Biological Diversity and concomitant international negotiations have pursued three main, explicit objectives: the conservation of biological diversity, its sustainable use, and the fair and equitable sharing of the benefits from utilising genetic resources. The Convention's key objectives have been consistently expressed. They will likely be renewed in substance in the next round of negotiations, the general framework of which will be decided at the COP15 in 2022.

While the general aims are relatively straightforward, this is not true of the critical pillars, directions or levers of strategic action[22]. The Aichi Targets (2010) helped clear the outlook by defining some twenty specific

22. Between the broad aims of the Convention on Biological Diversity and the concrete Aichi targets, this intermediate level should be introduced in the theory and structuration of strategic action. The hesitation between the three terms is voluntary since it is possible to consider this level as serving as the base of strategic action (pillars), what organises it (directions) and what is supposed to facilitate its rollout and efficiency (levers).

and concrete targets. However, a careful examination of official documents, scientific literature and biodiversity strategies and policies at different scales of action is essential to identify those pillars, directions or levers for action that remain insufficiently explained.

Protecting biodiversity from destructive humankind

Species and ecosystem protection is undoubtedly nature conservation's first and oldest pillar. Since humankind is at the root of many degradations, certain areas should be removed from its influence. This strategic direction has led to the creation of the first national parks in America, often considered the foundational act of nature protection policy. However, the movement to create protected areas has constantly oscillated between two 'poles': the 'preservationists', for whom nature is only valuable if it is removed from all anthropic influence, and the 'conservationists' concerned with conserving the functions and constituents of ecosystems without excluding all human activities. Despite tensions and sometimes violent opposition, these two poles are also observed in the policies adopted. Hence, the IUCN classifies protected areas into several categories, ranging from the wilderness reserves and national parks advocated by the preservationists to the protected areas that include human activities, as envisaged by the conservationists.

Beyond the debate inherent to the nature protection and conservation movements, the central idea consists in limiting and, where possible, removing part of nature from the impact of human activities. The biosphere reserves created under the MAB programme, designed to combine local development and protection, include all the reserve 'cores' (the central area) akin to wilderness reserves.

This form of action (creation of parks, reserves, etc.) has become increasingly important throughout the twentieth century (Figure 3). Several international conventions (CITES for international trade in endangered species of wild fauna and flora; Ramsar, the Convention on Wetlands, the Berne Convention) have been thus ratified, highlighting protection as a priority measure.

The Convention on Biological Diversity (1992) endorsed this approach as a priority and reaffirmed the importance of strengthening the network of protected areas:

> 'The fundamental requirement for the conservation of biological diversity is the *in-situ* conservation of ecosystems and natural habitats.'

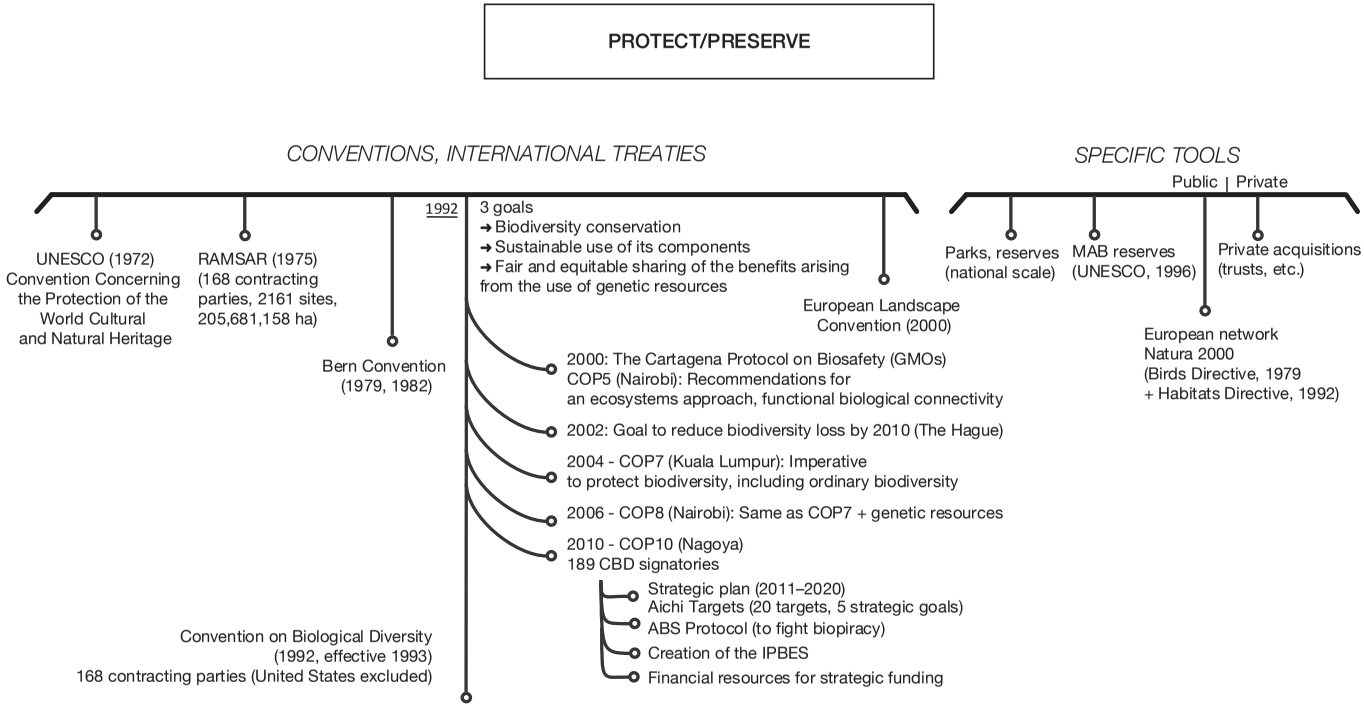

Figure 3. Key practical aspects of the 'protect/preserve' strategic orientation (source: Brédif, 2016).

In an opinion column published in November 2017 in the journal *BioScience*, 15,000 scientists (mostly biologists, physicists, astronomers, chemists, agronomists, or climate, ocean, zoology and fisheries specialists) issued a warning about the state of the planet. In this paper, they insist on the need for urgent action and propose twelve initiatives for immediate implementation, 'prioritising the enactment of connected well-funded and well-managed reserves for a significant proportion of the world's terrestrial, marine, freshwater, and aerial habitats'.

For the past seventy years, scientists and international bodies have been unanimous in considering protection as the pillar or priority strategic direction for the worldwide implementation of a vast network of solid protection areas (national parks, nature reserves, etc.).

This priority has led to a significant increase in the number and surface area of protected zones, nowadays representing close to 16% of the planet's land surface. The movement also applies to maritime areas: protected marine areas, which only covered 2.9% of aquatic environments in 2010, now cover 7.5% (Maxwell *et al.*, 2020). This trend is unlikely to stop or even slow down: the Aichi Targets included increasing the proportion of protected areas to 17% of Earth's land surface, a goal which should be raised to 30% at the COP15 in 2022. This protection network must be further strengthened and, above all, better connected through the implementation of ecological corridors. The Aichi mid-term review (2015) highlights several positive points which demonstrate significant progress in the field of protection (Figure 4).

In analysing research published in leading conservation journals, Laurent Godet and Vincent Devictor (2018) showed in *Trends in Ecology & Evolution*, that most research emphasised the relevance and successes of protected areas, with few acknowledgements of failure. For the authors, the review showed that protected areas 'still represent a key strategy for the success of specific conservation goals' and that, rather than criticising their inadequate results, they should be further developed. There is still a lack of comprehensive reviews on the effectiveness of protected areas to evaluate their real role in protecting biodiversity. In a recent dissertation (2020), Victor Cazalis offered a nuanced but optimistic assessment of the effectiveness of protected areas: studying bird populations, he concluded his work by showing that 'protected areas have no effect on the specific wealth of bird assemblages, but they do slow down biotic homogenisation (by favouring specialist species in forest habitats, both endemic and threatened)'. As we already know, certain protected areas are critical for

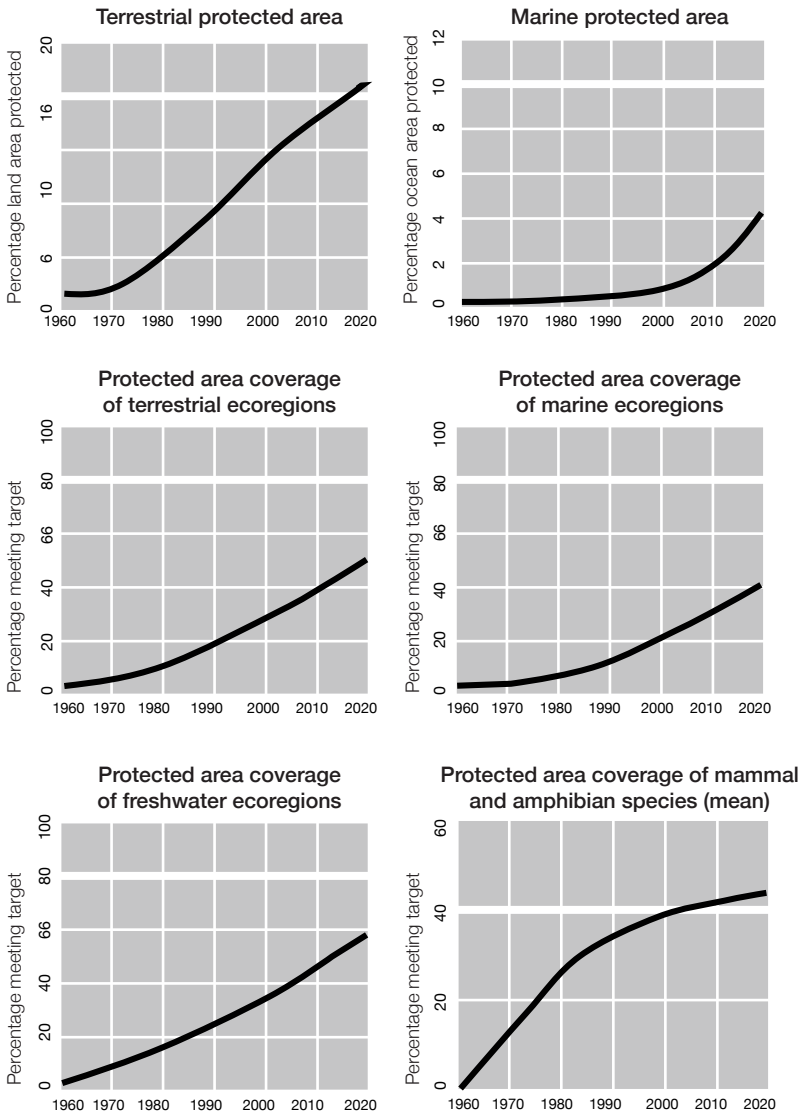

Figure 4. Aichi mid-term review on protection (source: Secretariat on the Convention on Biological Diversity, 2014).

the survival of numerous species. A study carried out by a group of international researchers in 2013 (Le Saout *et al.*, 2013) defined 137 critical protected areas worldwide: the survival of more than 600 animal species depends on these hotspots, over 300 of which are considered threatened.

Hence, protection efforts have helped avoid considerable losses regardless of their limitations. According to David Tilman *et al.* (2017), 'conservation programmes saved at least 31 species of bird from extinction in the last century—16 of which were saved between 1994 and 2004—and prevented an estimated 20% of threatened vertebrates from moving closer to extinction.' In a study carried out in 2012, Grégoire Loïs highlighted the decisive role of highly protected areas in the survival of many bird species (big wading birds, birds of prey, etc.) considered virtually extinct in the twentieth century and which are now in relatively high numbers.

Beyond mere figures, the protection of remarkable areas means that we can still enjoy the wonders of nature in the world's big national parks and wilderness reserves, which, as in the great Bialowieza forest in Poland, offer exceptional landscapes resulting from the multiple interactions of strikingly diverse flora and fauna. How can we not leave space to the wild, to free evolution, to the non-human, when anthropogenic biomass has recently exceeded non-human living biomass on Earth (Elhacham *et al.*, 2020; Bar-On *et al.*, 2018)?

Know, raise awareness and educate to mobilise

The second strategic direction concerns knowledge. Two points are regularly mentioned in this respect. On the one hand, the repeatedly expressed wish[23] of scientific habitats and NGOs to have better scientific knowledge of biodiversity, seen as an essential condition for action. On the other hand, the need to circulate this knowledge as broadly as possible for better awareness and mobilisation.

International reports and conferences regularly indicate that overall knowledge of the state and dynamics of biodiversity remains inadequate. How could it be otherwise when we know less than two million species for an estimated five to ten times more today? International programmes—such as DIVERSITAS, the BiodivERsA network at the European level, the

23. As early as 1948, the IUPN insisted on the necessary circulation of knowledge and the importance of promoting educational programmes. In 1949, during the Lake Success Conference, Jean-Paul Harroy, the IUPN's First Secretary General, declared that 'Unless people are aware of their moral duty and material interest in respecting the living associations that surround them and from which they derive their livelihood, there is no regulation, however severe, that will save these associations from degradation or even destruction, if economic profit is at play.'

global evaluation and inventory efforts, and the creation of the IPBES—are part of this rationale to develop scientific knowledge as an indispensable tool for better understanding and management. 'Thus, knowledge is a priority issue' (Direction régionale de l'environnement, de l'aménagement et du logement, DREAL, Nord-Pas-de-Calais). Like other countries, France created a National Biodiversity Observatory (ONB) in 2010.

Recent decades have witnessed an unprecedented commitment of funds to scientific research. Big international research programmes have generated a boom in the number of publications on biodiversity. The diagrams in Figure 5, taken from a study by sixteen Canadian scientists under the direction of Pierre Legagneux (2018), illustrate the scope of the efforts accomplished since the Rio Conference.

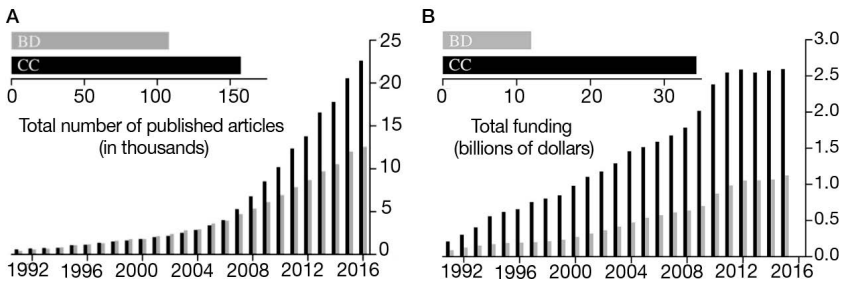

Figure 5. Overview of scientific articles published throughout the world and funds devoted to biodiversity (BD) and climate change (CC) research (source: Legagneux *et al*., 2018).

This knowledge in progress is not limited to scientists and decision-makers. It must be shared through education and information. The underlying idea is that the biodiversity crisis results from the wider public's insufficient awareness and knowledge of its scope. The aim is not only to make this knowledge accessible to as many people as possible but also to encourage citizens, especially those living in urban areas, to reconnect with nature. In this respect, particular attention is paid to children, the citizens of the future, who are considered more receptive to concerns about nature and seen as vehicles for spreading the message to previous generations. Here again, international texts promote education and awareness programmes for children.

Information campaigns and public events are part of this drive to circulate information and educate as many people as possible.

The Aichi Targets mid-term review, produced in 2015 under the aegis of the Secretariat of the Convention for Biological Diversity, stressed that:

> 'Data and information on biodiversity are being shared much more widely through initiatives promoting and facilitating free and open access to digitized records from natural history collections and observations, including through citizen science network.'

The same report outlines the efforts made by many developed and developing countries to raise public awareness of the importance of biodiversity and to promote education programmes.

The French National Biodiversity Observatory (ONB) regularly publishes indicators. These indicators confirm the increase in available resources for research, public aid to development in terms of biodiversity, and raising public awareness (Figure 6).

The results are there, as evidenced by the increase in citizen involvement in participatory science programmes[24] (+154% active participants between 2011 and 2017) and in biodiversity awareness and citizen education initiatives.

In this area, the strategy implemented has also produced rather significant results.

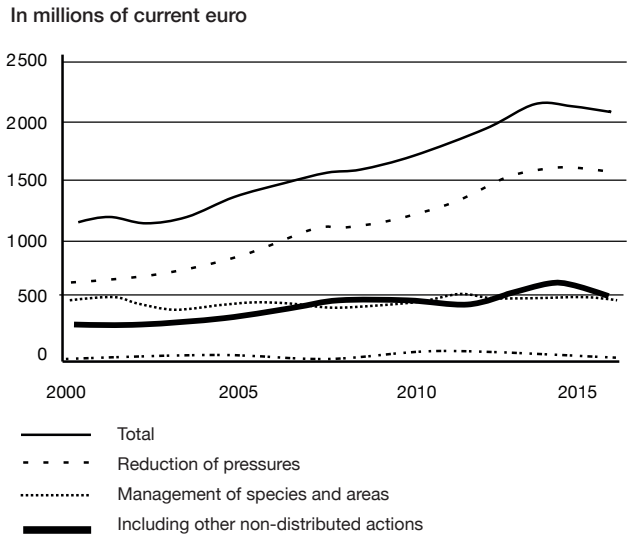

Figure 6. Evolution of national expenditure (in millions of euro) for protecting biodiversity and landscapes by primary action type (source: Joassard, 2017).

24. 'Participatory sciences are defined as the scientific production of knowledge involving the active and deliberate participation of non-scientific-professional stakeholders, whether individuals or groups.' (Houiller and Merilhou-Goudard, 2016)

Assess and value for better management

The third key strategic direction consists in promoting the utility of biodiversity. It has progressively led to the valuation of biodiversity. Already present in the Convention for Biological Diversity, the economic and monetary dimension has gained paramount importance over the last two decades. This strategic direction stems from several key convictions of environmental economics outlined in the 1990s:

– in line with the theses of Garrett Hardin (1968), the idea that a free public good, in this case biodiversity, is necessarily vulnerable and ultimately degraded;

– the absence of a stated monetary value is an invitation to overexploitation. By contrast, assigning a value or a price enables the market to play its regulatory role by integrating the cost of degradation into economic calculations—what economists call 'internalising externalities'.

From a strategic point of view, this approach is meant to be more 'eloquent' and subsequently to mobilise economic and political players, and even the wider public, who are deemed reluctant to recognise or admit the intrinsic value of biodiversity.

Finally, this strategic direction paves the way to adopting quantifiable measures, concrete incentives and sanctions, whose logic and implementation are, a priori, accessible and easy to understand. This approach points to pragmatism as the guarantee of effective action. Olivier Bommelaer (2011) expresses this in the following terms:

> 'Time to decide is short when the decision-maker must choose between the economic development of a territory and the conservation of its natural assets: often, he must arbitrate between this conservation … and a monetarily quantified economic benefit …: inevitably, the absence of monetary quantification is equated with an absence of value for society.'

As a result, international conferences and conventions since Rio have largely addressed the issue from an economic angle, particularly regarding the sharing of benefits derived from biodiversity and genetic resources. The Nagoya Conference (2010) was considered a success because it led to the signing of a protocol on access to the benefits of exploiting and sharing genetic resources.

Consequently, one of the most commonly used action methods is sanctioning, rewarding, and motivating players through financial measures. The tools implemented derive from three mechanisms. The first concerns all the measures adopted regarding payment for environmental services.

The aim is to remunerate practices that help to maintain biodiversity. The European Union, for example, offers a range of agri-environmental measures to indemnify or compensate for losses due to certain environmentally friendly practices. Here, value is a function of a social practice rather than a service provided by biodiversity. Alain Karsenty and Driss Ezzine-de-Blas (2014) describe this as the 'remuneration of an "agent" for a service rendered to other "agents" (regardless of where they may be in time and space) through an intentional action aimed at preserving, [restoring or] increasing an agreed … service'.

The second mechanism concerns what is often grouped under the term compensation. Such compensation forms part of an ARC[25] sequence designed: firstly, to determine whether it is possible to avoid (A) the impacts of an infrastructure; secondly, to consider possible reductions (R) of impacts; and finally, to compensate (C) for residual impacts, in particular by proposing conservation actions (pressure-relief measures and ecological engineering measures, according to Baptiste Regnery, 2017) capable of promoting biodiversity while respecting the principle of 'no net loss' or 'ecological equivalence'.

The third set of mechanisms concerns what could be termed 'market logic': private compensation banks, certifications, and green accounting—these are just some of the tools that involve private players, for the most part. These approaches are essentially '"cost-benefit" calculations that do not leave out the consideration of ecosystem degradation-related texts' (Maris, 2011).

These valuation mechanisms have produced results. Some examples are famous and have been repeatedly mentioned. The compensation mechanism for environmental services enabled the City of New York to reward the virtuous practices of farmers in the catchment basin supplying the city, thus avoiding the costly construction of a treatment plant. The case of Vittel water in France (Etrillard, 2016) and of the Nakivubo swamp in Kampala Uganda (Ring *et al.*, 2010) are based on the same mechanism. Significant results are regularly reported as regards compensation. Irene Ring *et al.* (2010) pointed to the large sums freed up for forest

25. ARC: Avoid Reduce Compensate. Doctrine designed to prevent developments from negatively impacting their environment, mainly to prevent any net loss of biodiversity in space and time.

preservation in India thanks to offset mechanisms and the results obtained in the United States by compensation banks for preserving wetlands.

Beyond concrete results alone, some authors have also shown that the monetary approach can lead to innovative strategies and mobilisation processes that open up broader perspectives than simply accounting for biodiversity loss. Stefano Pagiola *et al*. (2005) showed that in Central America, payment for environmental services had lifted many farmers out of poverty and had 'provided them with the means to invest in plantations and adopt silvo-pastoral practices for which they were paid following a precise scale'. Drawing on this example in particular, Alain Karsenty and Driss Ezzine-de-Blas (2014) emphasised that, under certain conditions, payments for environmental services could become a tool for local development.

Some research also stressed the potential for collective mobilisation, which could be associated with payment for environmental services, provided all stakeholders interact. Indeed, payment can be an opportunity for stakeholders to negotiate and agree on collective initiatives:

> 'Payments for environmental services schemes between upstream and downstream populations can be seen as win–win negotiated agreements (upstream populations are compensated for adopting practices that preserve ecosystems, and downstream populations get the benefits in terms of non-polluted water).' (Barnaud and Antona, 2014)

The same authors conclude their article by stressing that the payment for environmental services approach harbours the potential for collective action that even local authorities may ignore and that this approach would help move beyond mere market logic towards local and efficient forms of implementation.

A recent article by American ecologists and political scientists showed that under certain conditions (defining payment for environmental services programmes as voluntary incentives to conservation, focusing incentives on healthy ecosystems rather than on a single species, using private funds for incentives), such payments 'can be an effective tool for conserving endangered species' (Lien *et al.*, 2019).

Regulate and further integrate public policies

The Convention on Biological Diversity (1992) marked a turning point in the pro-biodiversity and nature approach. Until then, conservation policies had existed at the national level, protection mechanisms

(biosphere reserves under the MAB programme) supported in particular by the IUCN and conventions relating to specific issues (Cites, Ramsar). Still, they were only the premises of a global nature protection policy.

However, with the Convention on Biological Diversity, biodiversity governance attained international regime status, i.e. 'a set of implicit or explicit principles, norms, rules and decision-making procedures around which the expectations of actors in a given field of international relations converge' (Krasner, 1982). By the provisions of the Convention (articles 23 and 24), several specific bodies have been created: a general secretariat, a Conference of the Parties (COP), which brings the Member States together every two years to assess the progress of the Convention and define the work needed to implement it; and the Subsidiary Body on Scientific, Technical and Technological Advice, comprising experts from the Member States who generally meet twice between each COP and provide advisory opinions on specific issues. With the development of the work supported by the Convention on Biological Diversity, the biodiversity regime has expanded considerably; from 2000 onwards, it became a complex regime, 'a set of overlapping international institutions' (Morin *et al.*, 2020)—on a par with the climate regime.

Over time, the approach became resolutely global in both senses of the term. In addition to its planetary extension encouraged by the emergence of a new unified object, biodiversity, the Convention moved beyond the strict perimeter of nature protection to extend to the related fields of agriculture, development, trade and culture (Figure 7).

Political scientist Amandine Orsini (2017) mentioned this in the following terms:

> 'Gradually, it has become the central element of a veritable complex of international regimes, operating in conservation, agriculture, development, trade and culture. … The Convention on Biological Diversity affirms the existence of a complex of regimes centred on biodiversity—consisting of five pre-existing international regimes—which it progressively reorganises.'

However, the 1992 United Nations Framework Convention on Climate Change (UNFCCC) still contained few provisions for linking the various international regimes. For instance, it would not be until Article 14 of the Convention on Biological Diversity, entitled 'Impact Assessment and Minimizing Adverse Impacts', that elements of cooperation between States would be envisaged in the event of significant damage to biodiversity or for the contracting parties (States) to take the necessary steps to

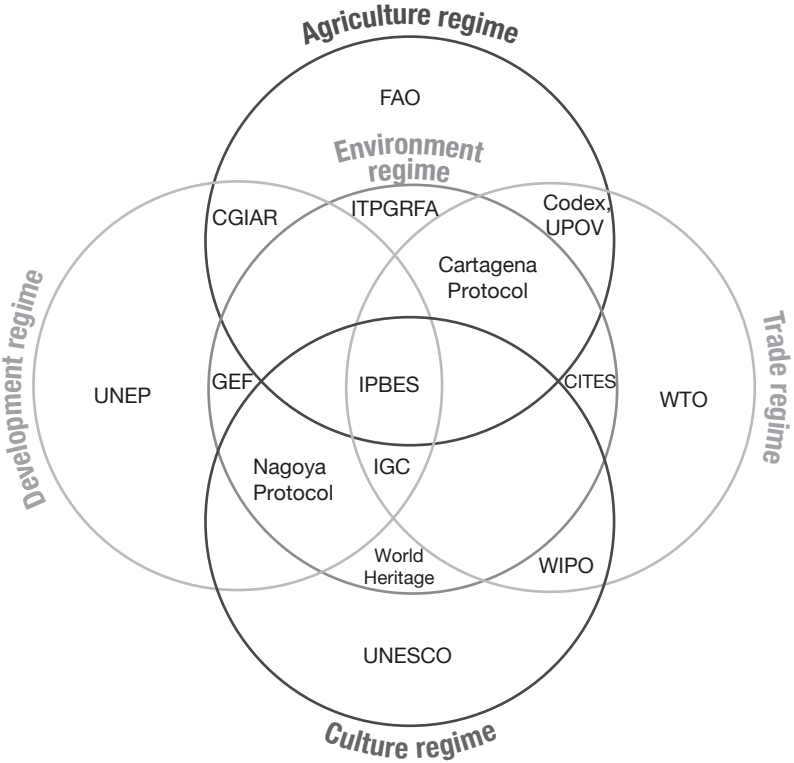

Figure 7. A complex of regimes centred on biodiversity and climate change (source: Morin *et al.*, 2020). CGIAR: Consultative Group on International Agricultural Research; CITES: Convention on International Trade in Endangered Species of Wild Fauna and Flora; Codex: Codex Alimentarius Commission; FAO: Food and Agriculture Organization of the United Nations; GEF: Global Environment Facility; IGC: Intergovernmental Committee on Intellectual Property and Genetic Resources, Traditional Knowledge and Folklore; IPBES: Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services; ITPGRFA: International Treaty on Plant Genetic Resources for Food and Agriculture; UPOV: Union for the Protection of New Varieties of Plants; WPO: World Intellectual Property Organization.

ensure that due account is taken of the effects on the environment of their programmes and policies likely to be significantly detrimental to biological diversity. Moreover, article 22, 'Relationship with Other International Conventions', is only a few lines long and is, once again, rather broad and open, merely mentioning the possibility that another international agreement might 'cause a serious damage or threat to biological diversity'. It would not be until the Nagoya Conference that the concern for better integration of biodiversity into other public policies would be asserted and the idea of greater coordination with different international regimes

pursued. These growing concerns are reflected in the formulation of the Aichi Targets, specifically in the previously-quoted Target 2, as well as in Target 3:

> 'By 2020, at the latest, incentives, including subsidies, harmful to biodiversity are eliminated, phased out or reformed in order to minimize or avoid negative impacts, and positive incentives for the conservation and sustainable use of biodiversity are developed and applied, consistent and in harmony with the Convention and other relevant international obligations, taking into account national socio-economic conditions'.

The international regime on biodiversity also relies on a set of valuation and global expertise schemes. In addition to the publication of the Global Environment Outlook, under the aegis of the UNEP, and the Millennium Ecosystem Assessment reports, which have played a significant role in disseminating the concept of ecosystem services, the creation of the IPBES in 2012 was intended to act as an interface between scientific expertise and governments; this is why it is traditionally compared to the IPCC for climate.

Ecologists, biologists and environmental activists regularly lament the fact that, compared to climate, biodiversity receives 'insufficient media coverage'. Specifically, they regret that the IPBES has not achieved the notoriety of the IPCC, even though it brings together scientific delegates from some 132 member countries. Would this mean that international negotiation and the search for a global approach to the issue of biodiversity loss have failed, as is sometimes claimed? Several points should be made in this respect.

In the space of a few years, the issue of biodiversity has finally made a breakthrough. Nowadays, it is commonplace to hear that, along with climate change, the erosion of biodiversity is the other major ecological issue of our time: official speeches, public policies at all levels of organisation, the more or less vigorous expressions of NGOs and the various movements of civil society, as well as corporate commitments repeat this over and over again. The rhetoric of climate emergency is undoubtedly more insistent and may sometimes convey the impression that it obliterates other environmental issues. In practice, however, climate and biodiversity now go hand in hand.

International negotiations relative to the Convention on Biological Diversity are more critical and constructive than ever. Curiously, the meeting of parties (MOP) and COPs on biodiversity generate less interest and

comments than those on climate change. However, judging by the continuity, richness and consistency of their outputs, they need not suffer in comparison. In addition to the various conventions (CITES, Ramsar) and specific protocols (Cartagena and Nagoya), which are part of the process and behind active public policies in their relevant areas, the UN process reached an important milestone in 2010 in adopting a plan with twenty quantified targets. Indeed, the Aichi Targets form a joint base, negotiated between Member States, that has no equivalent for climate. They provide a foundation for measuring and evaluating the efforts made by each party and, ultimately, the collective efforts made by the community of states. They are at the origin of ambitious land and marine area protection targets. On a broader level, the UN process is constantly fuelling and consolidating a global strategic approach to fighting biodiversity loss, which serves as a reference for the lower levels of management of the problem, from the continental to the national and local levels. As a result, most public strategies on biodiversity explicitly refer to this international framework, ostensibly drawing inspiration from it or endeavouring to comply with it—proof, if proof were needed, of its significance and decisive nature.

Finally, it should be noted that the debates, expertise processes and international negotiations regarding biodiversity and related challenges do not happen in a vacuum. There is a genuine concern among negotiators and experts to better link biodiversity issues in the strict sense to other significant public policies and international strategies. This concern is reflected explicitly in the quest for greater involvement of the various international bodies in the debates and negotiations of the Convention on Biological Diversity (Figure 8), precisely to ensure that policies relating to agriculture, development, culture and trade significantly consider biodiversity issues. It was also confirmed through the implementation of a 'liaison group' between the secretariats of the three big conventions[26] ratified in Rio de Janeiro, which had long preferred to work independently. Lately, this rapprochement materialised through the remarkable convergence on the soil issue; this common subject illustrates the evolutive and adaptative dynamics of international processes, which also learn from their errors and manage to move forward. As the economist Catherine Aubertin and the ecologist Danièle Magda stressed (2019):

26. Convention on Biological Diversity, United Nations Framework Convention on Climate Change, United Nations Convention to Combat Desertification.

'A new turning point was reached this summer with the special report on land use by the Intergovernmental Panel on Climate Change (IPCC), at a time when the fires in the Amazon offered a perfect and staggering illustration of the excesses of such use. … An unprecedented connection was forged with the IPBES by joining the conclusions of its March 2018 report on land degradation and its necessary restoration, but also that of the COP14 Convention to Combat Desertification held in Delhi in September 2019. The climate issue has emerged from its exceptional and overarching position to find new footholds in the field through multiple interconnections and alliances with other topics such as biodiversity, development and consumption models, North-South oppositions, etc.'

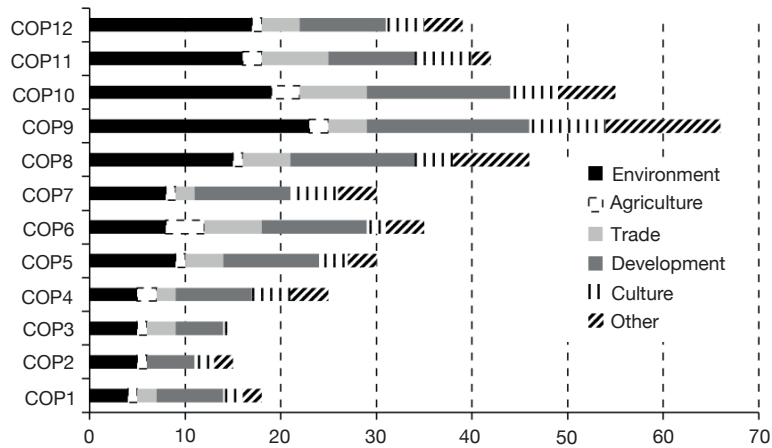

Figure 8. Affiliation with one of the regimes in the regime complex on biodiversity of the international organisations observing the COPs of the Convention on Biological Diversity (source: Orsini, 2017).

On the necessity of producing and consuming differently

In September 2020, following an informal preparatory meeting for the COP15, representatives from some 64 countries emphasised the following in the third paragraph of their joint declaration entitled 'Leaders' Pledge for Nature':

> 'We are in a state of planetary emergency: the interdependent crises of biodiversity loss and ecosystem degradation and climate change - driven in large part by unsustainable production and consumption - require urgent and immediate global action.'

Clearly, some ground has been covered since the Convention on Biological Diversity (1992), which had in no way challenged, least of all mentioned,

production and consumption modes[27]. Of the three objectives set out in Article 1 of the Convention[28], the sustainable use of the components of biodiversity is arguably the one that comes closest to the concepts of production and consumption Article 2, which focuses on the definition of the key terms used in the Convention, outlines what is meant by 'sustainable use':

> '[T]he use of components of biological diversity in a way and at a rate that does not lead to the long-term decline of biological diversity, thereby maintaining its potential to meet the needs and aspirations of present and future generations.'

How did the issue of production and consumption patterns end up taking on such importance? Although this issue is rarely studied, a two-pronged approach is probably appropriate.

First, the systematic investigations regarding the drivers of biodiversity loss are probably largely responsible for this. As international experts analysed the role played by habitat fragmentation, pollution and the overexploitation of resources in the decline of living things, they were naturally led to 'tracing the causal chain', i.e. to identify production and consumption patterns as playing a determining role in the rapid evolution of natural systems. Moreover, with the acceleration of the globalisation of trade, the phenomenon would become increasingly apparent, not to say intolerable: regression of the enormous equatorial forests for the monoculture of GMO soya, oil palm or beef farming, uncontrolled clearing and use of slash-and-burn leading to mega-fires with considerable health and symbolic impacts; the resounding impact of biomass energy crops on the cost of food production; the harmful effects on South American countries of the quinoa craze in countries of the Global North, or of superfoods such as avocado.

Second, the issue of production and consumption patterns gained momentum with field research substantiating the idea that 'teaming up with life'[29], particularly in agricultural production, is a way out of the

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27. These aspects were, however, already potentially present in the preamble to the 1948 Constitution of the IUPN, as the following sentence shows: 'Man must be made aware of the need to protect and even regenerate these resources and to consume them only sparingly, to guarantee the prosperity of the world and its future peace.'

28. Note that this refers to the conservation of biological diversity, the sustainable use of its components, and the fair and equitable share of the benefits of exploiting genetic resources.

29. In the words of Robert Barbault (2006).

usual vicious circles (lower yields, the race for synthetic inputs, endless host-parasite competition, and environmental, health and social costs that are increasingly difficult for people to accept). Whether referred to as the 'doubly green revolution' or the 'nature-based solutions'[30] adopted by the UN system, new agricultural production models encourage greater reliance on biodiversity based on natural variability. The result is more diversified production systems and gentler interventions, with sometimes spectacular results, including in terms of yields and the organoleptic qualities of productions. Incidentally, these models offer appreciable resistance and resilience when climate hazards emerge as a significant constraint. As a result, biodiversity is no longer viewed solely as a problem since it also brings solutions. And this is a true game changer.

These overall developments eventually found their way into the UN mechanisms of the Convention on Biological Diversity. Target #4 of the Aichi strategic plan explicitly refers to this:

> 'By 2020, at the latest, Governments, business and stakeholders at all levels have taken steps to achieve or have implemented plans for sustainable production and consumption and have kept the impacts of use of natural resources well within safe ecological limits.'

This target is the last of the strategic plan's first set of targets, entitled, 'Address the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society'.

Thus, the UN process around the Convention on Biological Diversity has recently begun to address the issue of production and consumption patterns. It had to reach a certain degree of internal maturity: monopolised by the issue of remarkable species and ecosystems and already quite busy with the direct determinants of biodiversity loss, its legitimacy to look into indirect determinants had long remained uncertain. It would also seem that an external development was profitable in this sense. Production and consumption patterns have been regularly questioned in the social debate for several years. Alongside repeated ecological and health catastrophes that pin the blame on productivist models, the very principle of a

30. The notion of *nature-based solutions* emerged under the impetus of the IUCN at the Copenhagen Climate Change Conference (COP15, 2009). Ever since, the concept has enjoyed growing international recognition. Overall, nature-based solutions are presented as actions based on ecosystems to meet global challenges, such as the fight against climate change and the management of natural risks.

transitional society has laid the foundations for various alternative models and other solutions, each more promising than the last.

However, regarding these aspects, the change stems less from the international negotiations themselves than from a fundamental movement in civil society. Indeed, since the late 1990s, NGOs have been very active regarding alternative production and consumption patterns, demonstrating a growing commitment in this area. Two primary forms of action can be identified. The first orientation uses information and awareness campaigns to raise awareness with the broader public and decision-makers. Drawing on global reports and expertise on biodiversity loss and climate change, some NGOs have recently developed a new form of activism to discourage consumerism and the quest for endless growth. They use a frontline, media-focused approach to production and consumption patterns deemed unsustainable or toxic, denouncing unacceptable practices threatening future generations.

Coinciding with the Convention on Biological Diversity, a second orientation has been to develop new standards for the sound management of natural environments before subjecting them to certification procedures by a neutral, independent third party. Initially launched by the WWF to promote sustainable forestry (Forest Stewardship Council), sustainable fishing (Marine Stewardship Council), and sustainable production of palm oil (Roundtable on Sustainable Palm Oil – RSPO), these initiatives have paved the way for an approach consisting in setting apart production models considered as intrinsically sustainable, even virtuous, from other production or exploitation models that are not sustainable, when they are not deemed harmful or toxic for human health and the planet. It helps to empower stakeholders in the production chain and enables consumers to make informed choices. This approach is now being used by other quality standards, such as organic farming, seeking to differentiate themselves from less virtuous production methods. In the wake of NGOs, other players have adopted this approach at a time of mistrust for industrial production and shifts in consumption patterns, specifically regarding food. New consumer trends that emphasise short distribution channels, local production and support for local territories and small producers are forcing entire industries to rethink their approach and major economic operators to take potentially significant initiatives. For example, a coalition of nineteen leading food companies with operations in one hundred and twenty countries and sales of $500 billion launched the One Planet Businesses for Biodiversity initiative in 2019. One of its

prominent leaders, Emmanuel Faber, then CEO of the Danone group, declared that,

> 'In light of the food and farming dead-ends we are heading towards, we must urgently work together with nature rather than against it. This is the aim of the coalition we launched at the United Nations today: to restore life to agricultural soils, reintroduce farmed biodiversity in our fields and radically change the face of deforestation. … Consumers know that through every purchase they make, they can "vote" for more sustainable production methods of the food and goods they consume, thereby redefining the social contract that binds them to nature, which puts biodiversity back at the centre of the economy and society.'

Intergovernmental negotiations on biodiversity, while less advanced in these debates and initiatives, also mirror the evolution of these fundamental movements in their own way and to their own extent, and try to keep pace with them. Two main avenues are being explored, judging by the COP15 preparatory documents. Firstly, all public (or private) subsidies that, in one way or another, perpetuate or even encourage production systems that foster biodiversity loss must be eliminated. One target, out of the future platform's twenty targets, addresses this challenge.

> 'Reform incentives, eliminating the subsidies that are most harmful for biodiversity, ensuring by 2030 that incentives, including public and private economic and regulatory incentives, are either positive or neutral for biodiversity.' (Target 12, Zero Draft of the Post-2020 Global Biodiversity Framework, 6 January 2020)

Even before the adoption of this new platform by the parties to the Convention on Biological Diversity, the revision of major public policies, such as the Common Agricultural Policy (CAP), had incorporated this dimension by introducing a set of new eco-conditions for supporting farms.

The second avenue for improvement highlighted by the Convention is the emphasis on nature-based solutions. No less than two of the future platform's targets explicitly refer to these new technological models, connecting them to the two other major global challenges: climate change and water supply.

Conclusion

A large community of thought and action, comprising scientists and experts from all over the world, mainly from the fields of conservation science and economics, generally affiliated with state bodies, NGOs and

sometimes private players, has gradually formed around the issue of biodiversity. This community rallied as the result of an observation which had been apparent for a long time but that it tried to objectify: the acceleration of the decline of non-human life forms. It has demonstrated the importance of the roles and functions played by biodiversity for human well-being, which is why biodiversity loss is a genuine concern.

Throughout decades of research and mobilisation, strategic action was gradually forged around three, constantly reaffirmed and embraced, key elements: biodiversity is first and foremost a biological reality; it is fundamental to societies; and it is currently under threat from those same societies.

Building on this 'diagnosis', strategic directions were gradually developed, focusing on necessary actions. They are more the result of the progressive incrementation of reflections and mobilisation over the years than well-articulated and consistent thinking from the outset. Although this is not always immediately apparent, strategic action to promote biodiversity is organised around five pillars (Figure 9). Together with the three overarching objectives of the Convention on Biological Diversity and the Aichi Target platform, these five orientations or pillars form the deep and stable structure of current action.

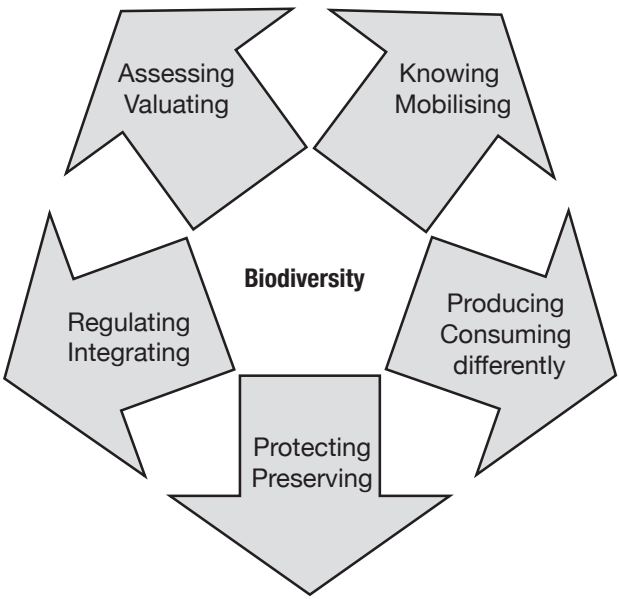

Figure 9. The five strategic directions or five pillars of biodiversity action (© Brédif and Simon, 2021).

Extensive mobilisation, the relevance of the action taken, the broadening of the strategy, which had been confined to protection measures for too long, the significant results achieved through the five major strategic directions: the results are by no means insignificant.

And yet, the situation keeps getting worse. In 2002, ten years after Rio, the Johannesburg Conference concluded that no significant results had been achieved. As Jacques Chirac put it, 'Our house is burning down, but we are looking the other way'. The objective set by the Conference was to reduce the biodiversity loss rate significantly. This objective was mirrored in all the action plans and strategies adopted at the European, national and regional levels. Eight years on, the situation remained the same. The Nagoya Conference (2010) (2010) opened with a speech by Ahmed Djoghlaf, Executive Secretary of the Convention on Biological Diversity, who proclaimed, '[L]et us have the courage to look in the eyes of our children and admit that we have failed, individually and collectively, to fulfil the Johannesburg promise made to them by the 110 Heads of State and Government to substantially reduce the loss of biodiversity by 2010. … The "170 fourth national reports" received by Parties to date confirm that we continue to lose biodiversity at an unprecedented rate.'

He even concluded by saying that 'we need a new approach'. The Nagoya objective is even more ambitious: to reduce biodiversity loss 'to almost zero by 2020'. The strategy was comprehensive and incorporated the five strategic directions previously described.

Yet, six years on, the Cancun Conference, intended as a progress review of the Aichi Targets, reflected further disillusionment. Of the twenty objectives, only four are on target; as for most others, no significant progress has been observed. 'To this day, only 5% of countries are on track to meeting these targets. This has not translated into sufficient national ambition and commitment', laments Deon Nel, Director of Conservation Programmes at the NGO WWF International. International reports are becoming increasingly alarming and point to the existence of irreversible tipping points that would threaten the very resilience of the system as a whole. This is the tenor of the IPBES report, ratified in Paris in May 2019.

All the efforts made, all the money invested, and the thousands of hours of meetings and conferences have failed to reverse the trend. Every ten years, the conclusions are the same: the diversity of life forms is dwindling, and the outlook is hardly cause for optimism.

What should be done then?

Should we 'change gears', and considerably strengthen the measures adopted to enhance protection, mobilise, value, regulate and change our production and consumption patterns? Should we, for example, set a target of 30% of protected areas globally, given that the 17% target set at Aichi was insufficient? Should we, as some are demanding, put pressure on governments to impose even stronger measures?

This is a possible avenue.

Should we not also question the limits of the action taken?

Is the diagnosis behind the action comprehensive? Do the strategic directions constitute a genuine strategy, or are they simply a collection of roughly convergent measures? Is it that each approach, taken separately, leads to preferring a particular course of action, a 'solution' that makes it inevitably partial and incomplete?

By taking a critical look at the strategic directions and related modes of action, a different approach may emerge, another way of formulating the diagnosis.

LIMITATIONS AND BLIND SPOTS OF THE STRATEGIES ADOPTED

As the previous section showed, the five primary strategic directions favoured by the international process to counter biodiversity loss have triggered little debate. However, how these directions are applied is quite another matter. The purpose of this section is to list the limitations and criticisms expressed by several qualified persons regarding the concrete avenues for actions selected for each strategic direction.

At first glance, this approach may seem disconcerting. Indeed, the purpose of our project is not so much to establish absolute truths as to bring to light and bring together what some specialists and experts have to say about the prevailing methods of action in the fight against biodiversity loss. These limitations and criticisms are rarely considered, if not largely neglected, by the official diagnosis underpinning the international strategy. They are often confined to one aspect or another, addressing the issue from the specific perspective of one discipline. They are so dispersed and fragmented that they are sometimes hard to spot and do not stand out in the general debate because they cannot 'form a mass'. These limitations and criticisms are nonetheless interesting and relevant insofar as they suggest that overriding options have been taken in how we act and that these options and preferences ultimately pose a series of more or less significant difficulties.

The matter is all the more sensitive because, as we emphasised earlier, the subject under consideration is not simply a question of science but concerns action and, more precisely, the effectiveness thereof. Ultimately, this raises the question of why the official strategy is not proving to be more conclusive, even though the strategic directions adopted have been widely validated.

We shall, therefore, proceed in successive stages, taking the time to list the limitations and criticisms and group them by central themes to build,

patiently and as methodically as possible, a general overview that is currently lacking. To this end, we have prioritised internationally recognised scientific research, both in the life sciences and the human and social sciences, as well as the reasoned opinions of qualified experts and several engaged stakeholders. Typically, the critical comments emanate from scientific journals, sometimes from official reports, and more rarely from the media.

It is not our purpose to say who is right and who is not. Instead, our purpose is to vary the angles of analysis and comments as much as possible to identify, through a combination of perspectives and expertise, the nature of the problem(s) encountered in the fight against biodiversity loss—in short, to gain a better understanding of how the international strategy is proving inadequate. Under these conditions, the singular opinion of a single person may be as valuable as that of a community of specialists, provided that it is sufficiently developed and argued; for all that, we will try to characterise the greater or lesser frequency of analyses, their degree of agreement, as well as the seriousness of the problems they raise according to the experts selected. Although our work does not claim to be exhaustive and involves a certain amount of subjectivity, we nevertheless hope, through this demanding effort to list and cross-reference analyses and criticisms, to highlight regularities in the reasons for dissatisfaction encountered and thus to gain a better understanding of the underlying reasons for the difficulties faced by the international strategy.

Most of the limitations and criticisms listed naturally gravitate around the five key strategic directions outlined in the previous section, and we will present them according to this rationale.

Protecting and preserving at the risk of sanctuarising

The opposition between the protectionist and conservationist approaches discussed in the foreword is not purely formal. It has 'spanned the history of nature protection' (Blandin, 2020). Now, the key texts we have mentioned and the appeals of scientists (*BioScience* opinion column, 2017) all stress the importance of exclusion zones and reserves designed to protect part of the biosphere from the destructive action of humans. They are quite evidently in favour of protectionism.

This rationale is based on the following scheme: as it is impossible to protect everything, the first step is to assess what needs to be protected

as a priority (because it is rare, essential and threatened), then to protect it from human activity (in whole or in part) by defining protected areas, and finally to maintain this natural asset through rules, standards and, if necessary, penalties. This approach is still very present, if not dominant, in the texts and decisions relating to biodiversity. As Alain Pavé, a specialist in biological and ecological systems, pointed out in his 2019 text,

> 'When one analyses the discourse on biodiversity …, one finds that the idea of conservation is omnipresent. For example, the law for the reconquest of biodiversity, nature and landscapes includes twenty-nine occurrences, strictly speaking, of terms associated with conservation, compared with two relating to evolution'.

A critical eye means looking at the difficulties encountered by this mode of action even though it is constantly being reaffirmed[31]. For although there has been an overall increase in the number of protected areas in the world, this development mainly concerns areas with limited protection (categories IV to VI of the IUCN classification). Although the surface area of protected land zones has increased in thirty years—between 1990 and today—from 8.3% to 15.3% of drylands, only a quarter can be assigned a high protection status (IUCN categories I and II). Presently, the rate of increase tends to slow down (Maxwell *et al.*, 2020) highlighting the difficulty and even resistance that stand in the way of the consistently reaffirmed desire for more protection. To this day, there is very little connectivity between these areas: Michelle Ward *et al.* (2020) estimated that only 9.7% of protected areas are now structurally connected by highly natural environments.

A rationale that separates remarkable biodiversity from ordinary biodiversity

The first observation that comes to mind when reading the documents and text which propose and organise protection measures is the priority given to remarkable, exceptional and endangered biodiversity through this mode of action. Since it is impossible to protect everything, it is crucial to prioritise the issues at stake to save what is likely to disappear in

31. By no means is this a question of validating the theses of the American 'neo-environmentalist' movement. Grounded in the absolute faith in progress and the unassailable resilience of nature, this movement rejects any idea of creating reserves and sees the anthropisation of the planet as an opportunity.

the short term. The French Foundation for Biodiversity Research (FRB) issued a report on the value of biodiversity (2013a), which expresses this in the following terms:

> 'Historically, biodiversity protection initially concerned the protection of rare, emblematic or threatened species. Alerted by naturalists on species decline (Pimm and Brooks, 1997; Leakey, 1999), public authorities created protected areas, thus acknowledging these biodiversity components' intrinsic and patrimonial value.'

The IUCN's efforts to establish lists of threatened species and habitats specifically focus on valuing this remarkable biodiversity. Hence, the famous IUCN Red List, which lists and prioritises species according to rarity and vulnerability (Robert *et al.*, 2017).

The classification criteria are well established. They consider the level of rarity (local, regional, national or international), type of rarity (endemic species, species with fragmented ranges, species on the edge of their distribution area), vulnerability (intrinsic fragility of the species, dynamics of the species and threat level) to produce a classification that identifies:

– very rare species present only in specific sites or locations;
– rare species present on less than 1% of the territory;
– uncommon species present on less than 10% of the territory considered;
– common species.

The rarity level is coupled with vulnerability prioritisation (a species can be rare without being threatened), which divides species into those with very high, high, relatively high and low vulnerability. The result is increased attention paid to very rare and highly vulnerable species, then to very rare and vulnerable species and so on. The same rationale is applied to habitats. This approach certainly facilitates prioritising issues. It is, therefore, an essential tool for action, but it contributes to focusing attention on the remarkable at the expense of the ordinary. Despite some evolutions, which we will discuss later, these lists are still essential tools for protection: they play a decisive role in the international delimitation of biodiversity *hotspots*, in establishing the European Directives behind the creation of the Natura 2000 network (the Birds Directive and the Habitats Directive) and in the choice at the local level of biotope protection orders in France.

However, these priorities are based on a now much-debated diagnosis. For some years, ecology research has stressed the danger of dissociating remarkable and ordinary biodiversity. In 2008, Kevin J. Gaston and

Richard Fuller, specialists in conservation biology, published an article which began as follows, 'The common species, those with large numbers of individuals compared with other species in the same taxonomic group, receive much less attention' and they concluded by stressing 'the need to pay increased conservation attention to common species'. In so saying, they asserted that it is indeed common species that shape the world.

This dissociation is detrimental in more ways than one. On the one hand, because common biodiversity is vital for retaining remarkable biodiversity. So-called common species account for most of the trophic flows on which remarkable species depend. In addition, species need to migrate and populations to meet to retain their genetic diversity and adaptive capacities. The need for ecological links, which is all the more essential given that climate change has made it imperative to maintain connectivity and the potential for species mobility, has been discussed extensively and resulted in the premises of concrete action. The implementation of the green-blue infrastructure and connectivity networks at different levels (international, national and local) reflects this awareness and the desire to create a network of protected areas.

On the other hand, such a dissociation disregards many species, mostly unknown or little-known, less visible than emblematic species, which we now know are sharply declining. Recent work by the Muséum national d'histoire naturelle (MNHN) has shown the extent of population losses among so-called common birds in mainland France, particularly in agricultural areas. A recent international survey by Gerardo Ceballos *et al.* (2017) has shown that 32% of vertebrate species are now experiencing population depletion, and 40% of mammals face considerable habitat reduction. The measures taken to protect remarkable biodiversity are therefore being questioned and challenged. This doubt about the efficacy of protection measures is expressed in a recent book by Jacques Blondel (2020):

> 'Apart from some spectacular successes, which inspire hope and deserve to be hailed, most conservation efforts have failed, although the number and extent of protected areas have increased in recent decades.'

By focusing on a few remarkable species (admittedly in the name of urgency), we are just looking at the tip of the iceberg, with the risk of allowing all other life forms to decline. However, this is a controversial criticism, and the debate is far from settled. Thus, Vincent Devictor *et al.* (2007) have demonstrated that protected areas contribute significantly to

maintaining more common species, albeit less threatened, whose populations decline nonetheless.

The rationale behind identifying remarkable species and habitats also puts the spotlight (financial, human and the media) on a few areas whose relevance is debatable.

> 'Biodiversity conservation budgets are insufficient given the number of species threatened with extinction: identifying conservation priorities is crucial. Because it is impossible to invest everywhere in the globe, scientists have defined priority areas in the form of hotspots.' Conservation Nature, http://www.conservation-nature.fr/
>
> 'In the United States, annual federal budgets for endangered species protection are huge (100 million dollars), and half of this expenditure is allocated to 2% of the species on the endangered species list.' (Gunnell, 2009)

Last, the species-centred approach is a source of conflict because it is based on a debatable diagnosis. The criteria for defining a rare species are, in many cases, open to debate: the great Alsatian hamster may be sharply declining in Alsace (where its presence is the result of a long history of human development), but it is still present and thriving at the heart of its natural range, in Central Europe: so is it a threatened species or not? According to the IUCN, corncrake has gone from a vulnerable species to a near-threatened species in ten years and is now back in the 'Least Concern' category. It is threatened in France, but the species is not endangered globally and even in Europe. By no means are we inferring that these species should be ignored, but we are simply pointing out that the criterion for classifying species is often open to discussion and potential conflict and, therefore, debatable. Caroline Dunesme expressed this in her thesis (2016):

> 'Listing, which is sometimes overestimated, certainly protects a species from extinction by identifying it as threatened (without any certainty as to the degree), but at the same time, it discourages the public, and even politicians, from conservation efforts, which are not justified by indisputable evidence that the species deserves the attention.'

A rationale that partitions areas

The protection rationale also entails partitioning space: on one side of the boundary, inside the protected area, there are rules, resources, species and remarkable habitats; on the other side of the limit, the ordinary and sometimes (often) laissez-faire. Signs or fences often materialise these boundaries. The IUCN's definition of a protected area is unequivocal in this respect:

> 'An area of land and/or sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means.' (IUCN, 2007, Almeria Conference)

Some authors, primarily ecologists and conservation scientists, such as David Tilman, still consider space partitioning the only possible solution to protect biodiversity. Only robust space partitioning, in light of demographic growth, can maintain the diversity of species and ecosystems 'by designating regions of higher biodiversity as protected areas and by concentrating food production in areas of relatively higher crop-yield value' (Tilman *et al.*, 2017). In his 2016 book, Edward O. Wilson goes so far as to advocate for protecting half of the planet.

Some fifty years ago, and in particular since the emergence of the MAB biosphere reserves, strict partitioning ceased to be viewed as the only possible means of protection. These reserves combine highly protected core zones, buffer zones (where human activity is possible but limited) and transition zones with fewer restrictions. In fact, this model inspired other protection schemes. It is the inspiration behind the new regulations for national parks in France (law of 14 April 2006). Similarly, the implementation of the green-blue infrastructure and ecological corridors designed to link biodiversity cores together bears witness to the fairly recent interest in areas with no protection status. Last, the IUCN classification of protected areas includes areas with a high level of human activities (categories V and VI). This shows that the divide is no longer as clear-cut as it was in the second half of the twentieth century.

But does this mean that the rationale has fundamentally changed? Nothing could be less certain. Several conservation scientists (Boitani *et al.*, 2008; Locke et Dearden, 2005; Bishop *et al.*, 2004), as well as many protection advocates dispute the validity of these categories, specifically rejecting IUCN categories V and VI—the least 'protective'—as protected areas. In 2002, John Terborgh and Carlos A. Peres expressed an opinion which is still shared by part of the scientific community and protection advocates:

> 'Much research confirms that humans and wild nature are incompatible except where humans practice a low impact pre-modern lifestyle at densities of no more than a few individuals per square kilometer. People damage the ecological system by clearing land, hunting, fishing, persecuting predators, and commercializing natural resources.'

The terms 'core zone' and 'central zone' indicate what this classification implies, i.e. that the best-protected areas are in category I and that the categorisation is a descending scale going from the best protected to the least well protected.

However, some authors have highlighted the lack of relevance of these categories: Shawn J. Leroux *et al.* (2010) environmental scientists at McGill University (Canada) and Berkeley (United States) have shown that the anthropic footprint was globally equivalent in category Ia, 'strict nature reserve', and other IUCN categories, including category VI! Thus, despite the significant changes that have occurred over the last three decades, the pinnacle of protection remains strict reserves, or even national parks, with the other categories being no more than substitutes meant above all, as Craig L. Shafer (2015) stressed, to protect core areas:

> 'The success of a buffer zone must be assessed first and foremost by its ability to protect the core reserve.'

However, the spatial segregation that results from this type of action raises several questions. The first relates to the quality and representativeness of the studies used to confirm the existence of remarkable areas. For example, geographers (Couderchet and Amelot, 2010) have shown inconsistencies in the delimitation of Natural Areas of Ecological, Faunistic and Floristic Interest (Znieff) in France (over-representation of certain regions, inconsistency on either side of administrative borders, etc.), which, although initially not intended for regulatory purposes, have served as the basis for outlining the Natura 2000 network. In an article by Ana Rodrigues *et al.* (2004) published in *Nature*, no fewer than twenty-nine conservation scientists pointed out that 20% of threatened species globally are not covered by protected areas. As the inventories are still far from exhaustive, particularly in certain parts of the world, sometimes, the resulting spatial divisions may be debatable, as may the representativeness of the chosen sites (Camm *et al.*, 1996; Brooks *et al.*, 2004).

A second set of comments concerns the implicit consequences of such spatial segregation choices. They tend to focus action on specific areas to the detriment of surrounding areas. Samuel Depraz and Adam Kertész (2002) have shown that, in former Eastern bloc countries, the development of protected areas was associated with the severe degradation of the surrounding areas, which were exposed to the adverse impact of heavy industry. Ultimately, parks and other protected areas are partly seen as 'an alibi policy that creates natural areas on paper and a legal corpus for show,

the better to divert attention from critical sectors'. Without going that far, much research has shown that by reducing access to local resources, the creation of natural reserves could result in the overexploitation of the surrounding areas, as Georges Rossi (2000) demonstrated with the example of Madagascar. A study of protected forest areas in the tropics (Laurance *et al.*, 2012) strongly emphasised this point:

> 'Crucially, environmental changes immediately outside reserves seemed nearly as important as those inside. … These findings suggest that tropical protected areas are often intimately linked ecologically to their surrounding habitats, and that a failure to stem broad-scale loss and degradation of such habitats could sharply increase the likelihood of serious biodiversity declines.'

Paul Arnould and Laurent Simon (2007) addressed the issue of risks associated with identifying hotspots at the global level by proposing a map of 'coldspots' or low biodiversity areas with little anthropogenic pressure. These global coldspots are primarily located in high latitudes and arid zones, among the most vulnerable to climate change. In so doing, they echoed the criticisms expressed by Peter Kareiva and Michelle Marvier (2003) regarding the simplifying effects of such divisions:

> 'Unwavering support for the protection of hotspots oversimplifies the difficult decisions that must be made in deciding which projects to fund and where to invest money.'

Naturalists such as Jean-Claude Génot in France take this line of reasoning even further, expressing concern about the pernicious effects of the general orientation that aims to save only the most remarkable. In his book *Écologiquement correct ou protection contre nature* (1998), he is not afraid to declare that:

> 'Nature is undergoing a crisis, and this time, we nature conservationists also have our share of responsibility. We've let ourselves be shut away too long in our nature reserves and other confined spaces, experimenting with "ecological engineering" and managing biodiversity, happy to finally have a place to express ourselves, technical and financial resources for our ecological gardening and recognition within society. Meanwhile, outside the reserves, developers are destroying ordinary nature, with the risk of someday rendering isolated reserves obsolete in overexploited and biologically impoverished environments.'

While this is a strong point of view which could be nuanced, it reflects one of the possible limitations of implementing dedicated protected areas. In addition, these areas often result from 'spatial compromises' between

the need for protection and the possibility of turning them into parks or reserves, compromises which can render the protected area partly unsuited to the objectives pursued. The need to accommodate existing populations often leads to restricting the protected area to the point that it cannot meet set objectives, and the surrounding area is impacted. A case in point is the many conflicts on the borders of parks and reserves caused by animals that leave the protected area. Examples include bears in the Pyrenees (Poinsot, 2008) and elephants in Africa (Bortolamiol, 2014).

Buffer zones and ecological corridors outside the designated areas do little to change the issue, save marginally. All they do is push back the limits of the contact area at the root of the problem. Vanessa Hull *et al.* (2011) observed this regarding Chinese protected areas, an observation that can be extended to many other countries:

> 'The biggest limitation of zoning schemes is that they are inherently difficult to enforce on the ground when it comes to individual animal and human behaviors because it may be difficult to draw "lines in the sand" where one zone begins and the another [sic] ends. While buffer zones can help in this regard, by serving as "fuzzy" boundaries, their effectiveness is limited when there are no physical boundaries separating zones.'

This conflict between (full or partial) protected area zoning and human activities may result in the creation of parks that only exist on paper, known as 'paper parks'. Lionel Laslaz (2018) mentions the case of Norway, a country regarded as attentive to protection, where 'only 25% of the country's protected areas have a management plan'! Guillaume Giroir (2007) uses the case of China to illustrate the discrepancy between the country's highly restrictive legislation and its reality, with parks that have no means or staff:

> 'Out of 226 national parks, 82 were illegally involved in tourism, mining, transport infrastructure, hydroelectric facilities, forestry and construction projects.'

Nowadays, alternative approaches to strict conservation are envisaged (Kremen, 2015). Far from dividing space between protected areas of biodiversity and areas with increased human pressure (land sparing), they contemplate a configuration of space (land sharing) that combines human activities (agroforestry, agroecology, etc.) and respect for biological diversity.

Again, the aim is not to challenge the principle of protected areas but rather to be in a position to question their limitations and relevance.

A rationale that puts a distance between biodiversity and human societies

More fundamentally still, the rhetoric (and the implementation thereof) is based on the earlier-mentioned partly debatable diagnosis of the negative influence of human activities on biodiversity: because humans are damaging biodiversity, they should be excluded from certain areas (parks, reserves, etc.) to allow biodiversity to express itself fully (Box 1). Yet, such partitioning between human activities and biodiversity is based on an incomplete and partially inaccurate diagnosis, leading to equally questionable action courses.

Box 1. Demographic pressure and biodiversity: reconsidering a causality

In a book published in 2003 (*Écologie et biogéographie des forêts du bassin méditerranéen*), Pierre Quézel and Frédéric Médail, comparing the plant diversity of Mediterranean regions, explained the exceptional position of circum-Mediterranean diversity by the weight of anthropic factors in the evolution of these environments. These views have since been widely confirmed, as shown by this excerpt from an article by Frédéric Médail and Katia Diadema published in 2006 in *Annales de géographie*:

> 'A summary of phylogeographic data on 75 plant species has made it possible to identify some fifty phylogeographic refuges in the Mediterranean region, special entities for conserving unique gene pools. … There is a close correlation between densely populated areas and the 50 refuge zones; in fact, almost 25% of the grids comprising refuges correspond to the sectors with the highest population densities (levels 1 and 2, i.e. between 250 and more than 1,000 inhabitants/km^2), located almost exclusively on the coast. Only 17% of the grids with refuges coincide with areas of low human density (0–50 inhabitants/km^2). Most of the grids (83%) with refuges have a population density of over 50 inhabitants/km^2, which is slightly higher than the average population density in Mediterranean countries (47 inhabitants/km^2) (source, FAO). These refuge areas are typically those with the highest biodiversity in terms of species and endemics, and these results are in line with the positive correlations previously observed between areas of high human density and species richness for various taxonomic groups.' (Araújo, 2003)

Similar results were found in other parts of the world, particularly in tropical environments (Balmford *et al.*, 2003). They show that the frequent correlation between intense demographic pressure and high biodiversity loss should be viewed cautiously.

On the one hand, it is an incomplete diagnosis because much research has shown that societies are critical players in promoting the diversity of life forms. On a very local scale, Antonio Ruggiero *et al.* (2008) have

demonstrated how artificial farm ponds promote the diversity of odonate (dragonfly) populations. On the scale of the South American continent, William Balée (2000), one of the world's leading specialists in historical ecology, has clearly shown that the extraordinary biodiversity of the Amazon rainforests cannot be explained without mentioning the positive role played by local societies for several millennia before the arrival of the conquistadors:

> 'The relatively high beta diversity of Amazonian rainforests is due to the agricultural activities of the people who have lived there for thousands of years and the domestication of the landscape they have undertaken, and not despite these activities. In fact, some landscapes would not exist if humans had not played an essential part in manipulating, retaining and extending biodiversity.'

This history has also produced landscapes rich in species and ecosystems both. Examples include the bocages of Western Europe, the wetlands shaped by centuries of exploitation, the agropastoral mosaics of the Mediterranean, the tropical agroforests studied by Geneviève Michon (2015), ethnobotanist and geographer, and the Chagas gardens of Tanzania, to name but a few.

The list of life forms that result from human activities would be long, starting with the extraordinary diversity of species and varieties of cultivated plants and farm animals. Recent research (Bull and Maron, 2016) also highlighted the significant influence of human activities on speciation processes. While humans are indeed the source of the current extinction crisis, and the overall assessment remains undeniably negative, their role cannot be limited to this negative aspect. Yet, this aspect is emphasised in much of the research, which, as a result, can only draw up a catastrophic assessment, as lamented by Christian Lévêque (2017), biodiversity expert with the Global Environment Facility (GEF) and former head of the French National Biodiversity Programme:

> 'For a scientist, however, the irksome thing is that in this field as in others, the discourse is Manichean and exclusively incriminating.'

Such an approach exclusively stresses the negative aspects of human activity (Figure 10) without questioning the creative contribution of societies. The overview provided in the *BioScience* opinion article signed in 2017 by 15,000 scientists is edifying in this respect.

If we look only at the negative points, the overall assessment inevitably becomes catastrophic, yet societies have also been able to maintain and even increase the diversity of living things.

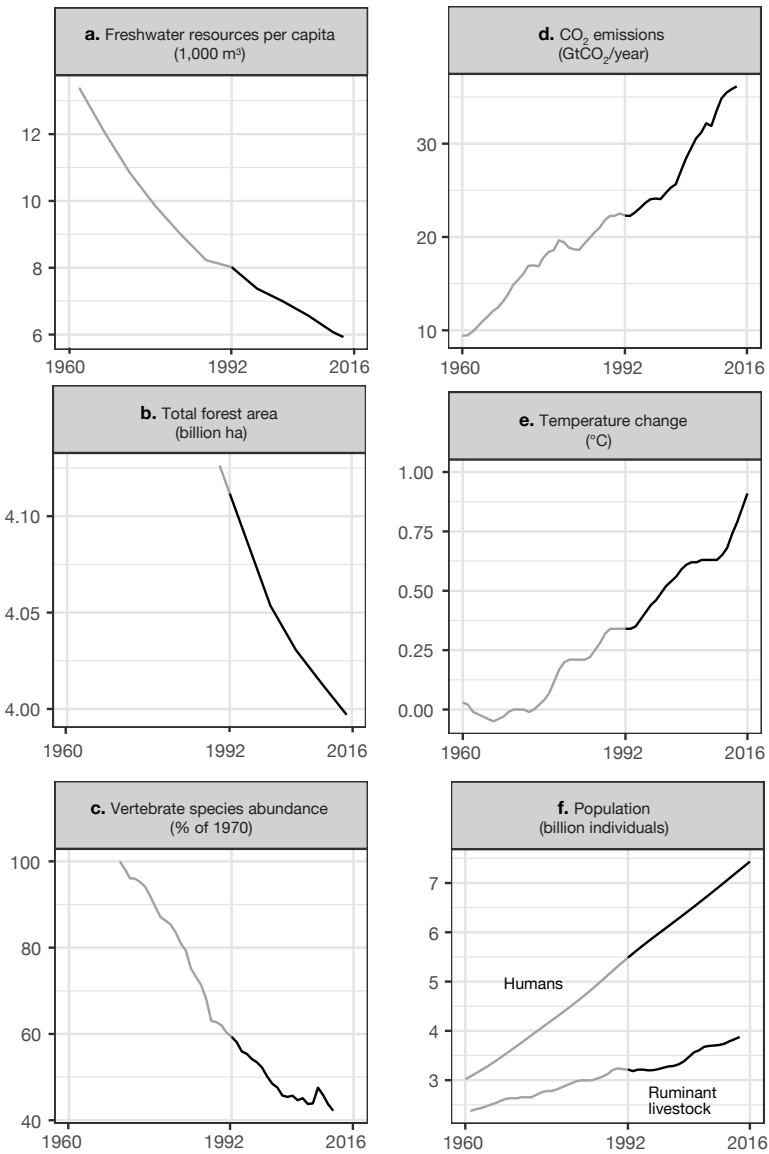

Figure 10. Trends in environmental issues identified in the scientists' 1992 warning to humanity (adapted from *BioScience* opinion article, 2017).

This incomplete diagnosis may result in an initial course of action that lacks relevance. In excluding humans from protected areas, they are denied the opportunity to contribute to maintaining the diversity of living things. We leave it to nature to restore, whereas in many cases, it

would be more appropriate to encourage local societies to support biodiversity. Hence, the exclusion of human activities has sometimes resulted in biodiversity loss. The case of Yellowstone National Park has often been cited: due to a lack of intervention and regulation, the population of red deer grew considerably, with excessive numbers contributing to the degradation of habitats (virtual disappearance of aspen, a species that is symbolic of the area) and the decline of animal species that depend on this habitat.

On the other hand, it is a debatable diagnosis because isolating biodiversity areas means placing their natural value over their patrimonial value in terms of biodiversity. Left to their natural dynamics, some environments can lose much of their specific and functional diversity through ecosystem homogenisation. Should former quarries, now rich in rock plants (Pech, 2013), be allowed to return spontaneously, 'naturally', to woodland, at the risk of losing this potential? Should the orchid-filled calcicole grasslands be allowed to evolve into forests, which may be more 'natural' but far scarcer in species? Should the reforestation of the Méjean Causse be allowed to proceed at the risk of losing an ecological heritage, the steppe grasslands, resulting from a long co-evolution with agro-pastoral societies (Blanc, 2014)? Hosts of such examples exist. The purpose here is not to settle this long-standing yet recurring dilemma. It is simply essential to remember that this dilemma exists and that protecting against humans is not necessarily the (only) solution.

Such an approach also means that aspects as fundamental as need, desire and emotion are excluded from the scope of protection. In areas where the aim is to involve local societies in biodiversity conservation, such marginalisation leads to a preference for utilitarian, extrinsic motivations over other, potentially more inspirational motivations. Today, the conservation of a habitat, however remarkable, is based on a scientific justification (rarity), technical justification (need to implement such and such a protection action) and political justification (its inclusion in the law) and, therefore, on procedures that are mainly foreign to local societies. The outcome is incentive measures that may be useful and effective but only engage the players' utilitarian (usually financial) motivations. Social science researchers have shown, however, that the capacity for commitment is all the stronger if it is based on broader motivations that incorporate the various dimensions of the relationship with nature: ethical, aesthetic, emotional, heritage and identity dimensions, everything that ultimately stems from a subjective relationship with non-human living things (Blanc, 2014;

Monteil, 2018). The 'cold' reason (financial, essentially) is only one of the levers—not necessarily the most efficient and sustainable—for commitment to biodiversity. We believe that the approach put forth by Baptiste Morizot in his latest book (2020a) is far more liberating and motivating:

> 'If we no longer view ourselves as humans in the face of nature, but as living beings among living beings, we are no longer protecting nature as a wild otherness, nor nature as a vulnerable-otherness resource: we are defending the community of living beings to which we belong, and which sustains and makes us.'

We should add the hiatus resulting from the approach to biodiversity viewed as a reality external to humans. When we protect an animal species, we do so in the name of a scientific category and a scientific judgement. Or, as Dorothée Denayer *et al.* (2016) stressed:

> 'On the one hand, science divides organisms into homogeneous groups known as species. … But in the field, conservationists deal with specific individuals and are therefore regularly required to revise their judgement of what the beings they claim to be responsible for are or are not capable of. …'

Protection in the name of a category reduces and even denies the human dimension of the encounter, which essentially resides in emotions and perceptions, fears and desires. While one refers to History with a capital letter (Natural History in this case, since we are dealing with species and humans guilty of damaging them), the other refers to contingent histories, those experienced by humans in contact with certain animals, all of which are singularities.

It also runs counter to the desire expressed by some for the reconciliation of humans and nature, seen as one of the conditions for effective action to fight biodiversity loss:

> 'Current measures (implementing natural reserves, regulation on the uses of nature), adopted for the obvious reason of protecting biodiversity, tend to amplify this separation and, consequently, people's ignorance of the biological reality of their identity and their connections with the natural world.' (Fleury and Prévot-Julliard, 2012)

In addition, zoning in the name of remarkable biodiversity may seem socially unacceptable and, hence, neither efficient nor sustainable. Countless population displacement and expulsion cases from previously appropriated and developed territories may be quoted (Brockington and Igoe, 2006). The consequences are often dramatic for the populations impacted. Many times, such exclusion is seen as a form of discrediting local players who are deemed a priori incapable of protecting the species

or the habitat (Laslaz *et al.*, 2014), although the very presence of the species or habitat in the area in question tends to be proof of a relatively protective environment management.

This exclusion is also experienced as a dispossession, a despoiling of the land, which is at the root of the many conflicts that have marked the history of parks and reserves worldwide (Rossi, 2000; Rodary *et al.*, 2003; Laslaz *et al.*, 2014) The fear expressed by Philippe Descola (2008) of 'local populations condemned to severely limit their use of these areas, where they have often lived for several centuries, or even to abandon them altogether' in the name of biodiversity protection has never been more topical. In a recent declaration (April 2022), more than two hundred organisations and experts expressed concern regarding the 30% target of protected areas set out in the COP15 preparatory texts. They asserted that 'this target is counterproductive and could further entrench an outmoded and unsustainable model of conservation that could dispossess the people least responsible for these crises of their lands and livelihoods'[32].

Such dispossession is all the more controversial in that it has often been combined with excluding the poorest populations, while the richest have benefited from the possible fallout of protection. In this respect, the Masai Mara National Reserve in Kenya is an old textbook case (Rossi, 2000; Hughes, 2010). However, more recent studies attest to similar processes even today: in India, Frédéric Landy *et al.* (2014) have conducted research in the Sanjay Gandhi National Park in Mumbai (Bombay), which bears witness to the marginalisation of poor populations due to protected area zoning. Concerning protection policies in Africa, Guillaume Blanc (2020) referred to the 'war for biodiversity', highlighting the violence that permeates many protected areas and the prevailing neo-colonial logic. The social sciences, specifically geographers, have clearly emphasised the adverse effects of the marginalisation of local populations and the ensuing domination rationale. Admittedly, the overall picture should be qualified. Since the 1970s and the MAB programme, approaches have considerably evolved, and many protection programmes now integrate local situations and stakeholders and combine development projects with protected areas. The exclusion rationale remains obvious when it comes to emblematic areas, areas of remarkable biodiversity that we would like to preserve from anthropic degradation.

32. https://www.ldh-france.org/wp-content/uploads/2020/09/en-fr-es-it-de-200928.pdf

Ecotourism has often been presented as the solution for combining conservation and development. The following definition supports this thesis: ecotourism is 'responsible travel to natural areas that conserves the environment, sustains the well-being of the local people, and involves interpretation and education' (The International Ecotourism Society). However, this approach very quickly revealed its limitations and characteristic contradictions: in addition to the voluminous research (Froger, 2012; Coria and Calfucura, 2012; Wondirad, 2019) that highlights the limited and often highly unequal local benefits of ecotourism, an insurmountable contradiction lies in encouraging the influx of tourists to protect a nature designated as 'wild'. In Madagascar, for example, where ecotourism is developing (Lapeyre *et al.*, 2007), certain strict reserves, such as Tsingy de Bemaraha, have been declassified to encourage tourism (Bidaud Rakotoarivony and Ratrimoarivony, 2006). Moreover, limiting the number of visitors is conducive to the emergence of elite tourism, which is hardly more satisfying socially.

A rationale that freezes biodiversity

Another set of limitations concerns the contradiction of prescribing designated areas and species to protect biodiversity, which is fundamentally dynamic, changing and partly unpredictable. The protection policy went global during the twentieth century in a scientific context that was still primarily inspired by Odumian ecology. This model looks at ecosystems from the thermodynamics perspective and its ability to 'create and maintain a high state of internal order' (Barbault, 2006); the model is one of equilibrium, in line with the notion of climax, and of stable exchanges within the ecosystem. In the 1970s, this highly fixist approach was criticised and challenged (Dobzhansky, 1973; Holling, 1973), and the role of disturbances was emphasised from the 1980s onwards by Steward Pickett and Peter White (1985) and then very quickly by the scientific community as a whole. Incorporating the contributions of historical ecology (Balée, 1994, 1998; Crumley 1994), Patrick Blandin (2019), the first director of the MNHN's Grande Galerie de l'évolution (Gallery of Evolution), calls for a definitive break with the 'ideology of equilibrium' and develops the idea of 'ecological systems [that] could be in a state of permanent change, and therefore have a history'. The paradigm shift is dramatic: it is no longer a question of equilibrium but of 'co-change', the 'joint transformation of the planet and its living fabric … that includes humans'.

This raises the question of reconciling set limits with constantly changing ecological dynamics. If we must think in terms of trajectories (Blandin, 2019) rather than equilibriums, could protection, in setting limits, be nothing more than the legacy of an outdated ecology and, therefore, a mostly inoperative one? In seeking to conserve, are protection policies not freezing the dynamics of living things? Could they be trying to (re) establish a state of reference, an equilibrium that does not exist?

This discrepancy between a fixist approach to protection and the advances in evolutionary ecology was firmly challenged in a 2017 article by sixteen French scientists from the MNHN and the Centre for Functional and Evolutionary Ecology (Cefe) (Robert *et al.*, 2017). They emphasised that the current progression of the biodiversity crisis is in no way comparable to the 'natural' rate of species evolution and, consequently, that the protection of species today also contributes to maintaining threatened evolutionary potential despite the fixist aspect of the term conservation. They partly rejected the criticism of protection that would focus on emblematic species, stressing that these species are not only highly vulnerable but that their role in communities and ecosystems is crucial and that protecting them helps protect all the species linked to them. Moreover, the authors explained that the aim is not to maintain a state of equilibrium but rather a potential for evolution, which concerns not only the specific level but, more broadly, all three main levels of biodiversity. Therefore, criticising protection policies because they favour an outdated approach to ecology is not or no longer relevant, according to these authors who support global protection efforts in the name of a dynamic and evolutive approach.

Yet, is this not a similar situation to that decried by Pierre-Henri Gouyon in 1995, 'Knowledge and action are notorious for being as complementary in the abstract as they are antinomic in practice'?

Indeed, while protection policies are compatible with a dynamic theoretical approach to ecology, it is no less accurate that they entrench several realities and that, in practice, their actions still rely on a relatively fixist rhetoric and decisions that do not integrate dynamic aspects clearly.

Implementing a protected area with its constraints, administration, regulations, and spatial boundaries implies a framework that is difficult to evolve. Protected areas created in this way become intangible realities, even when the objectives assigned to them are achieved. The sustainability of the measures adopted is not restricted to parks and reserves. In terms of compensation measures, some States or regions (for example,

the States of New South Wales and Victoria in Australia, the State of British Columbia in Canada for wetland compensation, Germany, and the United States) have imposed perpetuity!

How can such a framework account for the unpredictability of ecological processes? Some authors have raised questions in this respect. Andrew P. Hendry *et al.* (2017) stressed the substantial uncertainties surrounding the evolutionary processes and ecological dynamics at work.

Many examples of unpredictable (and unforeseen) ecological dynamics are indeed challenging to address within an area defined by established rules. Once again, species dynamics in Yellowstone National Park bear witness to this, with the meteoric rise of the red deer, followed a few years later by that of the wolves, endangering the deer populations. As Yanni Gunnell pointed out (2009), 'this suggests that ecosystems are mostly metastable, i.e. they go through successive stages which are more or less stable, but never identical. The logical conclusion drawn from this observation is that the tendency to transform nature into a museum, and thus to want to freeze its states, is a mistake'. Christian Lévêque summed this up in a recent book (2017):

> 'Acknowledging complexity has a corollary: it forces us to admit that there is a degree of indeterminacy in nature, that there may be a part of randomness, contingency, catastrophes, improbable events.'

A degree of indeterminacy that also reflects positive dynamics and the sometimes unsuspected capacity of living things to regenerate (Box 2).

Box 2. The regenerative capacities of living things, a reality

Maintaining and developing genetic diversity calls for the existence of a sufficient amount of metapopulations to facilitate exchanges between individuals and the essential genetic blending. However, in the isolated environment of the Kerguelen Islands, population genetics research has shown that starting with two mouflons introduced in 1957, the population of the species had not only increased considerably but that its genetic diversity had also evolved well beyond anything that the models could have predicted, thus 'illustrating the extraordinary adaptive reservoir of living beings leading to unexpected diversity' (Pavé, 2019).

This is a well-known dynamic at the species level, demonstrating the species' recovering abilities. As highlighted by Baptiste Morizot (2020a), 'The original Darwinian force of pullulation is such that if living conditions return to favourable, then from an ember, a small population (as long as it is sufficiently genetically diverse), a flourishing population can be reborn, capable of major evolutionary radiations towards unheard-of forms of life'. This is the case for many birds of prey, which have been legally protected since 1972. Nowadays, there are eagle owls in Camargue and peregrine falcons throughout France. Other locally extinct species are being

reintroduced: griffon vultures, cinereous vultures and bearded vultures are now reproducing in the wild. There were virtually no large mammal predators left in the wild in the mid-twentieth century. Currently, there are some hundred lynx in the Jura region and around sixty bears in the Pyrenees. Wolves number around 1,100. Otters and beavers are recolonising many rivers from which they had disappeared entirely.

Finally, the (re)creation of certain habitats bears witness to the possible dynamic of living things. Alain Pavé (2019) used the example of the garden at the École normale supérieure in Lyon, created twenty years ago with 250 plant species. Today, the garden counts 350 additional species that settled spontaneously, brought by the wind, birds and humans. 'A model that would have predicted such an evolution would not have seemed credible!' In agricultural zones, the mere presence of grassed strips at the borders of plots results in a significant increase in entomofauna, which in turn boosts plant diversity. Even vaster spaces have experienced biodiversity regradation following ecological restoration work: the experiments carried out in the Crau (Tatin *et al.*, 2013) and in Denmark in the Skjern estuary (Pedersen *et al.*, 2007) highlight, among others, the possibilities of reclaiming formerly degraded environments.

Species mobility, resulting from climate change and set to intensify, also raises questions regarding the relevance of fixed and permanent areas to meet conservation challenges. Will protected species migrate out of these areas when others move in? Short of protecting 50% of the planet's ecosystems, as Edward O. Wilson demands, there are grounds for questioning the ability of protected areas to play their role in a context of increased mobility, all the more so if we follow the opinion of David Tilman *et al.* (2017) who, in line with several authors, suggest installing physical barriers to avoid conflicts around protected areas.

The very idea of conservation, whatever the merits of the observations put forth by Alexandre Robert *et al.* (2017), encourages a fixist or fixed interpretation of biodiversity, which is more assimilated to a given than to continuous creation or a process in the making (Brédif, 2016). *Ex situ* conservation projects in gene banks are an obvious illustration. This is also what Pierre-Henry Gouyon lamented when he denounced the strategy of putting biodiversity 'on ice' symbolised by the Svalbard Global Seed Reserve Project. The evolutionist points to the triple aberration of this project, which is intended to preserve the planet's entire food biodiversity. First, he questions the possibility of maintaining the germination capacity of seeds over the long term, particularly for tropical species. Then, he observes that biodiversity should be seen first and foremost as the result of evolving processes rather than a freeze-frame on species seen as autonomous entities. Finally, he notes that this amounts to denying that the formidable cultivated biodiversity is the result of the work of

generations of farmers throughout the world, whose survival and ability to continue their work of selection and creation should be guaranteed rather than dispossessing them of their land or forcing them to use standardised seeds (Brédif, 2016).

This is undoubtedly what one might term, following Paul Pierson (2000), a phenomenon of 'path dependence': 'Once established, patterns of political mobilization, the institutional "rules of the game", and even citizens' basic ways of thinking about the political world will often generate self-reinforcing dynamics'. The scale, duration and results achieved by protection measures seem to obliterate other possible means of action and hamper an in-depth reflection on the limits and impasses to which they lead.

A rationale that pits stakeholders against one another

The rationale which, in the name of threatened remarkable biodiversity, results in the creation of highly protected areas (IUCN categories I to IV) is based on an asymmetry of knowledge and power. Asymmetry of knowledge because action goals are decided based on scientific knowledge, and therefore, expert knowledge, which is not a priori open to debate. Asymmetry of power, because in most cases for category I to IV areas, public authorities decide to establish a protective perimeter within which a set of regulatory constraints are imposed. Of course, these are not arbitrary decisions. They address the obvious concern to protect a shared asset, understood as a biological given that needs to be conserved. Therefore, strong protection areas primarily involve national and international players who act in the name of a shared asset regarded as superior to and beyond the reach of local contingencies. While this is a perfectly understandable rationale, its limitations should also be considered. As already pointed out, the criteria used to define this common asset, even when based on scientific knowledge, are often debatable (is the species really threatened? Is regulatory protection indispensable?) and hence they are debated. Most of all, though, this rationale excludes local populations from the definition of the common asset, its management and fundamentally, its ownership and acceptance. Consequently, the common asset is imposed upon the territories from the outside. In 2017, Jean David Abel, Vice President of France Nature Environnement (FNE), perfectly outlined the issues that result from this approach in France:

> 'Biodiversity-related issues and conflicts are addressed by inadequate governance, which generates blockages and divisions rather than experimentation and innovation. Our State, which is still very centralist in many of its structuring decisions, fuels representation conflicts and "central" divisions, virtually based on identity and often mediatised, which, far from encouraging the resolution of problems and the integration of solutions into local practices or decisions, nurture antagonisms and foster misunderstandings and deadlocks.'

The adverse effects of such top-down practices have been known for some time. To limit their impact, several texts and documents call for the contribution of local players. In her PhD dissertation, Clara Therville (2013) outlined the major paradigm shifts in protection policies over the last decades and the shift from a segregative to an integrative approach involving local populations. In France, the law on national parks was modified to encourage the participation of local authorities in the decision-making process at the national level. Every major international text stipulates that participation is a prerequisite for the success and sustainability of protection operations. However, participation is still widely conceived of as a means of ensuring the acceptability of a project that has been defined upstream. The leading international texts still envisage it as a tool to serve predefined targets. In this respect, the wording used in drafting the Aichi Targets is symptomatic, 'Enhance implementation through participatory planning'. As Richard Raymond (2009) pointed out, participation thus becomes a tool for legitimising decisions that have already been made.

While nowadays, participation is mentioned and implemented in several protected areas, particularly IUCN categories V and VI, typically, it only mitigates conflicts: it is equivalent to a compromise that leaves out essential aspects. Coralie Mounet (2006) provided a significant example with the wolves in the Vercors Regional Nature Park, which includes a national nature reserve. As a protected species, wolves belong to remarkable biodiversity, 'their legal status places them in the realm of sanctuary nature. In theory, therefore, wolf management is purely regulatory (protection) and biological (monitoring, etc.)'. However, the park and the reserve have chosen a different avenue, involving the participation of and negotiation with local stakeholders, and in particular with livestock breeders: regulatory measures have been envisaged, thereby breaching the reserve's regulations and objectives, and resources have been mobilised to support livestock breeders, who have agreed to change their practices. In a way, the park acted as a mediator between local players and a structure that is supposed to enforce national regulations. Consequently, it created

a 'situation conducive to local concerted management. The local level can be a forum for mobilising stakeholders in a participatory management process by "cobbling together" a common framework.' Therefore, the involvement of local stakeholders resulted in a compromise. However, this compromise remains fragile, as it is likely to be called into question due to changes in the local context (predation pressure, regulation authorisations, etc.), and it also meant setting aside some of the regulatory principles and standards of strong protection. Although this approach was innovative and productive, it resulted in a temporary and limited agreement that only imperfectly considered the objectives of long-term protection and local needs for sustainable farming conditions.

Previously, we outlined the limitations of this participatory approach. The most common objective is to achieve self-limiting rules and compromises to preserve what can be preserved of biodiversity and possibly to make different uses of biodiversity compatible. Still, these rules and concessions essentially consist in reaching an agreement on the constraints consistent with the interests of every stakeholder. (Brédif *et al.*, 2017).

Strong protection and biodiversity conservation tools remain marked by the asymmetries we mentioned earlier (Brédif and Simon, 2014). While remarkable biodiversity is clearly identified, scientifically based and validated by experts, ordinary biodiversity is more challenging to apprehend unequivocally. While the former is partitioned and identified in designated areas (parks, reserves, etc.), the latter escapes predefined spatial divisions. Whereas one is managed by a single or dominant player, the other involves many players with different aspirations and perceptions. Diversity of players, values and projects: what matters is overall diversity, not just ecological diversity.

Criticism review

Based on the criticisms and discussions mentioned above, more or less radical challenges to the strategic direction in question (protect) emerge. The ecological relevance and effectiveness of protected areas are still being debated, although the principle of protection zones is never challenged. The debate mainly concerns the life sciences and ecology in particular. It does not inevitably pit ecologists against one another, but it does involve contradictory arguments. Some of the arguments raised highlight existing risks: the divide between remarkable protected biodiversity and ordinary biodiversity in decline and exposed to degradation; confirmation of the

existence of unprotected areas that are nevertheless important for biodiversity; and finally, freezing biodiversity in determined and stable areas. However, other elements underline the results achieved regarding protection or the evolution potential preserved through these reserves and national parks. Overall, criticism of the effectiveness of protected areas remains mitigated: few would like to see them abandoned, but many would like the approach reconsidered in terms of its methods and importance.

These debates, which primarily emanate from life science researchers, are also confirmed by social science studies, which point out that a lack of public support often results in the degradation of ecosystems in and around protected areas. Hence, the very principle of protection is not challenged, but it does give rise to debate, lively at times, as to its actual efficiency.

However, the methods used to implement protected areas attract more radical criticism. The very principle of defining protected, therefore remarkable, areas has pernicious effects in that it concentrates funding and resources on limited areas. In contrast, all researchers agree that maintaining biodiversity requires a more comprehensive approach. This criticism is directed at the zoning system itself.

Most researchers, particularly in the human and social sciences, view excluding human populations (or the constraints imposed on them) as counter-productive. Special mention is made of the unfair and arbitrary nature of these decisions, which are often imposed, do not encourage local players' mobilisation, and can lead to conflict. Although there have been significant developments towards taking better account of these social dimensions, this has rarely been the case for highly protected areas. Some conservation ecologists also point to the perverse effects of distancing local populations, namely the loss of contact with nature that it implies. Here, the very capacity of these mobilisation tools is being thoroughly called into question.

The most fundamental criticism, which casts doubt on the principle of protection designed to isolate nature and remove it from supposedly destructive human activities, is mainly expressed by humanities and social sciences researchers. Historians, geographers, ethnologists and anthropologists agree on the need to reconsider the protectionist postulate that regards humans as an entity in itself, an abstract category that has caused the current biodiversity crisis. They criticise this univocal connection and underlying abstraction. While humans have indeed been undermining the diversity of life forms for decades, not all humans, and even less the

human species as a whole, are to blame. This is a radical criticism insofar as it challenges the initial assumption (humans are destroyers; they must be excluded from protected areas). Most researchers from these disciplines emphasise that, in many cases, societies have, on the contrary, maintained the diversity of life forms and even helped them flourish. They refute the systematic connection between humans and the destruction of nature, and hence the premise of protection (in the protectionist sense of the term). Whether or not degradation occurs depends on social and cultural contexts and historical situations. The degree of convergence between the social sciences on this point is sufficiently strong to be highlighted. It has, however, drawn on research in ecology, which has demonstrated the sometimes positive role of societies.

Knowledge and mobilisation at risk of commodification

Since 1948, international texts concerning nature protection have continuously stressed the need for a better understanding of biological diversity as a central element of the measures designed to protect nature, educate people, and raise awareness.[33] From the global to the regional level, strategies and action plans are based on two self-evident assumptions: the more we know, the better we can act and the more likely we are to mobilise.

This is a position that is widely shared beyond international bodies. Referring to the research of sociologists Céline Granjou and Isabelle Mauz (2007), Laura Rodriguez *et al.* (2018) mentioned a 'scientific imperative' and stressed that:

> 'Environmental action must be based on scientific knowledge, methods and concepts. In France, this scientific imperative has resulted in a tendency to use professional and technical expertise, based on scientific ecology, as the only legitimate knowledge for action on nature.'

33. As early as 1949, at the Lake Success Conference, the IUPN recommended that UNESCO inform governments of the urgent need to introduce the concepts of nature protection and conservation into the curricula of primary and secondary schools, universities and technical schools, either by creating specific courses or by including lessons on these issues to existing courses.

This eminent role assigned to scientific knowledge is also logically claimed by scientists themselves, a large proportion of whom share the opinion of Carl Folke *et al*. (2011) who wrote that:

> 'Science has responsibility to provide a better understanding of the challenges facing humanity, and to explore pathways toward a sustainable world.'

Scientific knowledge is therefore viewed by international institutions, government representatives and the scientific community as a whole as an essential prerequisite for action. It is supposed to inform action, legitimise it and render it comprehensible.

Such a strategic direction, which seems to stand to reason (who would question the usefulness of scientific knowledge?), is, however, based on three more or less implicit assumptions with far-reaching consequences:

– that scientists can provide an unequivocal assessment, a clear and shared diagnosis;

– that this diagnosis includes the identification of the causal relationships that are essential to the recommendations to act;

– that this diagnosis is sufficiently accurate and comprehensive to guide action and even be the source of the solutions put forth.

These three postulates are relevant if biodiversity is only viewed as a property of ecosystems, an object of study outside of subjective realities, something that can be described, quantified and whose dynamics can be evaluated. But are they still relevant in light of the wealth of subjective, emotional and cultural links between humans and the diversity of living things? Finally, are they relevant to understand the full complexity of the challenges and issues at hand? Ultimately, the strategic focus on the need for knowledge leads to defining action plans regarding:

– progress in the scientific understanding of gene, species and ecosystem diversity (development of research programmes, inventories, etc.); scientific disciplines viewed as capable of providing indisputable results (resulting from a consensus in the scientific community) are prioritised, which significantly reduces the possible scope for intervention by specific approaches in the human and social sciences;

– the increased role of expertise meant to translate 'the' science and say what can be done, i.e. the creation of the IPBES, national agencies, etc.;

– the need for sharing knowledge through education.

Although we highlighted the significant results of this strategic direction earlier, it should also be noted that its presuppositions and action methods have been and still are widely debated and sometimes radically questioned.

The impossibility of an objective overall assessment

The scientific communities working on biodiversity issues, particularly in the life sciences, are now in a position to make an unequivocal observation: that of the accelerated loss of the diversity of life forms over several centuries, and specifically since the advent of the industrial era. While there is no doubt about the overall picture, when it comes to specifying the precise rhythms, methods and processes involved, there is still a considerable amount of uncertainty shrouding our knowledge. Those who make this observation are mostly life science researchers. First of all, the current picture is still quite incomplete. We only know a fraction of the living world: just under two million species, estimated at between 5 and 100 million. As Patrick Blandin (2010) put it with a touch of humour:

> 'Let's assume that there are only 100 million species left to discover, all categories combined; at a rate of 50,000 new species inventoried per year—and we're nowhere near that—it would only take 2,000 years to complete the inventory.'

While some taxonomic groups (vertebrates, vascular plants) are well known, we are still considerably ignorant regarding insects, fungi and even more so, bacteria. These taxonomic biases were recently stressed by Julien Troudet *et al.* (2017), and their importance was emphasised in an August 2018[34] publication by the French Foundation for Biodiversity Research:

> 'This is known as a taxonomic bias, and while it is omnipresent in biodiversity research, it is seldom studied, little understood, and therefore rarely, if never taken into account in research results, even though it is known and its consequences may prevent drawing general conclusions on all life forms and implementing effective protection programmes.'

In addition to these taxonomic biases, there are geographical biases, as demonstrated in a study by an international team of ecologists and geographers led by Kerrie A. Wilson (2016):

> 'Countries where we stand to lose the most biodiversity are currently underrepresented in the peer reviewed literature and international fora, and this situation will only be reinforced by strong publishing biases.'

34. https://www.fondationbiodiversite.fr/les-donnees-de-la-biodiversite-biais-taxonomiques-en-lien-avec-les-preferences-societales/

While we can hope for much quicker progress in the future thanks to environmental DNA[35], for example, exhaustiveness remains impossible. Over and above the inventory, the rhythms and modes of evolution of the diversity of life forms are still largely unknown. In a summary article, Andrew Balmford *et al.* (2003) showed the extent of the uncertainties that still hamper work on the extinction rates of species: many extinctions, even in known taxonomic groups, are still undetected; comparisons between current rates, even imperfect ones, and rates estimated for periods prior to human action are hardly relevant; lastly, the links between species losses and habitat losses are proving difficult to establish, and the use of indicators is scientifically debatable. While the authors do not challenge the overall observation of rapid decline, they stress that there is still a significant measure of uncertainty. Looking at two of the major causes identified, habitat fragmentation and invasive species, it is easy to see the remaining scientific uncertainties regarding the diagnosis of biodiversity loss itself (Boxes 3 and 4).

Box 3. Are habitat loss and fragmentation always a source of biodiversity loss?

All the major texts dealing with biodiversity loss depict habitat loss (the H in HIPPO-C) as the leading cause of the current crisis. Expert reports traditionally point to fragmentation, particularly of the great tropical and boreal forests, as the cause of this loss of habitats, which must be halted at all costs.

Following several articles on the subject (notably by Lenore Fahrig and Robert J. Fletchter, considered world references), the journal *Biological Conservation* published a highly significant update (Fahrig *et al.*, 2019). It admittedly reaffirmed that habitat loss on a global scale is indeed a major cause of species extinction and biodiversity decline. However, it specified that the connection between fragmentation and biodiversity loss is far from firmly established. The thesis defended by Lenore Fahrig (2018, 2019) leads to the following conclusion: 'The idea that habitat fragmentation is generally bad for biodiversity is a "zombie idea"—an idea that should be dead, but somehow remains very much alive'. Lenore Fahrig and her colleagues pointed to the sometimes positive consequences of fragmentation: edge effects, increased habitat diversity, improved connectivity, etc. Yet this debatable argument is constantly raised by conservation organisations to justify specific protection measures, particularly the protection of large, unfragmented areas.

However, Robert J. Fletchter *et al.* (2018) have discussed Lenore Fahrig's work and contested various of its aspects. Expressly, they pointed out that species favoured by fragmentation are only sometimes treated as conservation

35. Environmental DNA (eDNA) is defined as DNA that can be extracted from environmental samples such as water, soil or faeces without isolating target organisms first.

priorities, that they may be potentially harmful invasive species, and that some of the criteria used by Lenore Fahrig need to be revised. The perspective in the journal *Biological Conservation* concluded this review with the following:

> 'The conclusions of Fahrig (2017) may appear surprising to many of us, but they highlight the need to ensure we continue to investigate central questions in conservation biology and check the evidence supporting our understanding and decisions. Conservation biology is currently re-examining many of its central tenets.'

This shows that systematically regarding habitat loss and ensuing fragmentation as undeniable causes of biodiversity loss is excessive, to say the least, as are the measures adopted in response. Caution should be exercised regarding this critical point.

Box 4. Are invasive species the enemies of biodiversity?

Invasive species (the I in HIPPO-C) have long been accused of being the second main cause of biodiversity loss. Therefore, in theory, their development should be limited as much as possible and, where possible, they should be eradicated. In this sense, research by Annelaure Wittmann and Alheli Flores-Ferrer (2015) showed that between 2009 and 2013, 19 million euro (including working hours and management costs) were spent every year fighting invasive alien species in France alone.

While the diagnosis is indisputable globally, more precise approaches demonstrate that caution must be exercised when dealing with this phenomenon. In a review published in 2010 in *Conservation Biology*, Martin A. Schlaepfer *et al*. highlighted, beyond the uncertainties which are inherent to the very notion of invasive species, the potential benefits of these species for biodiversity. Occasionally, they can provide habitats for other species, be a food source, enable restoration processes, replace extinct taxa and even increase the supply of ecosystem services.

Clearly, beyond the shared observation of the considerable reduction in the diversity of living things, asking science to provide a precise and indisputable diagnosis, both of the current state of biodiversity and its evolution and the causes of this evolution, is in part a fiction that could contribute to delegitimising scientific research.

Although scientific research may provide an 'objective[36]' overview of the state of knowledge at a given point in time, with the degree of uncertainty we just mentioned, it cannot claim to hold an absolute truth. Scientific research is never set in stone. Laura Rodriguez *et al.* (2018) perfectly illustrated this. While Odumian ecology, which prevailed until the 1980s, encouraged the conservation and protection of equilibria, over

36. Objective in the sense of impartiality and the result of a consensus in the scientific community.

the last twenty years, functional ecology has placed greater emphasis on the co-evolutionary phenomena between ecosystems and human societies (Blandin, 2019). 'These evolutions in terms of knowledge and conception of nature may influence the practical sphere' (Rodriguez *et al.*, 2018). Indicators, intended to inform decision-making, also reflect scientific concepts and the state of research. A team of one sociologist and two ecologists (Deuffic *et al.*, 2016) thus discussed one of the key indicators of biodiversity-friendly forest management: 'dead wood volume'. Long ignored, from the 2000s onwards, dead wood was considered an indicator of the wealth of forest species, particularly saproxylic species, and by extension (debatably) biodiversity in general. Philippe Deuffic *et al.* (2016) evoked this extremely rapid change:

> 'Such has been the production of knowledge in this area that, of the 35 indicators produced, the dead wood indicator is one of the few retained by the French National Biodiversity Observatory (ONB) to provide an overall picture of forest biodiversity levels. As a result, the deadwood indicator in France went from being an unusable indicator in 2005 to a reference indicator in 2011.'

However, this trendy indicator is again under debate and, at best, provides only a partial assessment of biodiversity.

As scientific knowledge evolves constantly, many 'established notions' are now being rechallenged. While scientists have long agreed on the importance of large ensembles for maintaining biodiversity, a recent study by twenty-two researchers from seven different countries, led by Lenore Fahrig (2019), co-director of the ecology laboratory at Carleton University in Canada, concluded that:

> '[T]here is no empirical evidence supporting the widespread assumption that a group of small habitat patches generally has lower ecological value than large patches of the same total area .'

These doubts, which are part and parcel of scientific knowledge, are also partly why Laura Rodriguez *et al.* (2018) called for the epistemic commitment of scientists. In an article bringing together philosophers and ecologists, they showed how communities of researchers mobilise different types of knowledge to respond to biodiversity issues (protected area zoning/impact studies/ecological restoration) and how these types of knowledge ultimately reflect different conceptions of nature:

> Nature as the legacy of endemic or characteristic species and co-evolution with extensive human activities for conservation;

> Nature as a legacy of legally protected species or species with a high conservation value for Environmental Impact Assessments (EIA), and
> Nature as the heritage of disrupted functional networks that can be restored to a certain extent through the appropriate arrangement of functional building blocks for ecological restoration.'

From the outset, by endorsing research geared towards action in favour of biodiversity, the conservation sciences have made a commitment that influences research, its hypotheses, methods and conclusions. This does not challenge the quality of the work completed, but it does qualify its potential for objectivity (Pestré, 2011).

These comments in no way invalidate the declared need for a better scientific understanding of biodiversity and the essential efforts that still must be made in this field. They certainly do not imply that scientific research is useless or, worse still, inaccurate. Their purpose is to highlight the limits of this conception of science as a mobilising force, rather than to challenge the very principle of the effort undertaken.

A significant gap between science and action

The expectations that science will provide solutions are partly rooted in the idea, broadly shared by scientists, activists, citizens and even politicians, that the solutions exist and that they are known, in short, that the knowledge (by which we mean 'scientific' knowledge) is there, but that it is the decision-makers who lack the will to take the necessary measures. In an editorial dated 18 May 2018, the French newspaper *Le Monde*, which is very active on these issues, headlined 'Biodiversity: the urgency of politics'. The article stated the following:

> 'But on the biodiversity front, the political vacuum is all the more incomprehensible given that the solutions usually involve simple measures that governments can take locally and independently.'

Mention was made of simple measures and the exact text mentions, two lines later, the need to change the dominant agricultural model! This type of reasoning typically informs opinions on climate change:

> 'Scientists have been telling us for decades. Over and over again. Far too many leaders have refused to listen. Far too few have acted with the vision the science demands.' (António Guterres, UN Secretary-General, 10 September 2018)

Similar reasoning applies to biodiversity nowadays:

> 'Given the gravity of the issues at stake, we, as scientists, expected a strong commitment from the State. … The government must take action.' (Opinion column in *Le Monde* by several renowned scientists on the subject of biodiversity, August 2017)

However, this reliance on science stems from a double equivocation, which should be highlighted.

If, despite the limitations mentioned above, climate and life science scientists are indeed able to accurately describe the state of the system and draw up a biological and ecological diagnosis of the system, this diagnosis is only partial, as it essentially excludes the social, human and cultural aspects of the issue. The knowledge thus provided is far from covering all of the fields involved.

It is scientific knowledge. It is not (at least not directly) geared towards action. This shows a confusion between science and expertise. Scientists describe the world as they analyse and understand it, whereas experts suggest what should be done, and it is up to politicians to decide what can be done or not.

This double equivocation, for want of being thought through and discussed, fuels a partly biased discourse which attributes to scientists knowledge that they do not have (at least not entirely), to politicians powers to act that they do not necessarily have, and which envisages problems and solutions with a simplicity they do not have.

On the Lure Mountain (Simon, 2006; Anselme *et al.*, 2010), scientists from the French Institut National de la Recherche Agronomique (INRA, today known as INRAE) indicated that to be maintained, the Lure fir —the local variety of Pectin fir considered at the time as a heritage tree from a genetic point of view (Sagnard *et al.*, 2002)—should be encouraged to spread to the ridges. The Orsini's Viper specialist (Lyet, 2008), a rare and protected species, claimed that the species' survival depends on the contrary on maintaining open and rocky spaces and that the main threat to it would be forest recolonisation. Science enlightens, but choices remain to be made and solutions to be invented.

While wolf specialists can agree on the data regarding the species' territories and its reproduction and distribution dynamics, they are more at a loss to give a univocal answer regarding its impact on biodiversity. Marie Chandelier *et al.* (2016), through a research project combining linguistics, ecology and geography, have shown that renowned and competent scientists can work together and use scientific arguments to support groups with opposite viewpoints concerning the impacts of wolf populations

on biological diversity. As such, scientists cannot claim to have all the answers when trying to answer questions intended to inform action.
Similar examples abound. Although firmly grounded, scientific knowledge does not systematically lead to simple, applicable solutions. This is all the more true as biodiversity always involves complex systems.
The bottom line is that scientists can only provide answers to scientific problems. They may attest to the existence of a phenomenon, demonstrate the mechanisms at work, and envisage possible developments (thus already entering the realm of the uncertain), but more rarely say what actions should be taken. In an article on mosquito control in the Camargue region, Fanny Guillet and Laurent Mermet (2013) clearly demonstrated the complexity and the limits of scientific diagnosis. Faced with the local players' request to initiate a mosquito control process in the western part of the delta, scientists can 'only' observe and demonstrate the adverse impacts of mosquito control on biodiversity. Having expressed this observation, the problem remains unsolved, as the issue cannot be reduced to a statement that the 'good health' of biodiversity has been affected. It also involves how the various stakeholders see and experience the territory, whether or not they accept the presence of mosquitoes and whether or not they want them eradicated. Scientific knowledge informs choices, but in no way should it dictate them.
Uncertainty is even more manifest when expert assessments, such as those of the IPCC and IPBES, are based on change scenarios. In 2013, the French Foundation for Biodiversity Research published a review of forecasting and modelling studies. Such studies are essential, and they are always presented with the necessary precautions regarding their degree of uncertainty when published in scientific journals. Nonetheless, there is often a gap between the scientific publication and its subsequent use, resulting in the scenario becoming a prediction. 'Scientists tell us that in 2050 …' How often has such a sentence been repeated in the media and by politicians? As Jacques Theys (1991) observed, we expect straightforward responses to complex issues. In a recent book, Alain Pavé (2019) emphasised the significant degree of unpredictability, the sometimes 'erratic' pace and the role of chance in the evolution of ecological systems. Modelling and ensuing scenarios, when used with the necessary caution, can only lead to potential developments that ultimately reflect a situation of uncertainty. Expecting science to be able to predict the future is tantamount to denying the creative dimension of living things and their capacity to adapt and innovate. It is another form of fixism in our

approach to the issue. If we accept this element of uncertainty, forecasting may once again become relevant, inviting us, in the words of Christian Lévêque (2017), 'to think of the future as a space for projects'.

Awareness of this degree of uncertainty is all the more essential given that a substantial proportion of the scientific community has endorsed a whistleblowing role. Given the growing body of research on the extent of biodiversity loss, such a position is certainly understandable. While science can provide irrefutable evidence of the accelerated loss of biodiversity and highlight the foreseeable consequences for several species and ecosystems, it can only offer hypotheses as to the scale of the crisis and suggest avenues for action.

Indeed, translating scientific results into action implies, in particular, a great deal of caution and an ongoing assessment capacity shared by all stakeholders, not only scientists. Landscape ecology, which has developed over the last decades, has highlighted the role of ecological continuities in population dynamics and the essential role of exchanges between animal and plant populations. These findings gave rise to public policies at the European level and then in France with the implementation of the green-blue infrastructure. Fighting landscape fragmentation due to the many existing infrastructures is undoubtedly positive. However, turning the green-blue infrastruture into a planning tool that should be applied nationwide is somewhat debatable. Alan Pavé (2019) bluntly raised the question:

> 'Is it possible that the trend for "ecological corridors", encouraging the passage of individuals of such species, might lead to results that run counter to expectations, i.e. a reduction in biodiversity, even though these corridors are supposed to preserve them?'

While ecology research stresses the critical role of connectivity (between individuals, populations and ecosystems), it also shows that a corridor only works for certain species, that the corridor of some species can be a barrier for others, that it may facilitate biological invasions, that isolation can also lead to forms of speciation that encourage the diversity of life forms. In short, generalising a scientific concept in a planning policy is not always and everywhere relevant. At the very least, it should be regularly assessed, which is far from the case.

Moreover, these corridors are part of populated and built-up areas where hosting remarkable flora and especially fauna is not a matter of course. The success of the tiger reserves in India is a case in point. The dynamics

of protected populations have resulted in their spreading to rural and sometimes urban areas (Guillerme *et al.*, 2009; Landy *et al.*, 2014), causing particular problems regarding tiger and human cohabitation. The strict application of scientific principles in urban planning illustrates the dangers of viewing scientific results as mere recipes to be followed.

Another consequence of this approach is the risk of hampering decision-making. The precautionary principle—first brought up at the Rio Conference in 1992 and included in the 1995 Barnier Law in France and the Charter for the Environment—stipulates that the absence of clear scientific evidence must not hinder action. Still, it is often interpreted in a sense that may limit it. Bruno Latour (2010) denounced those who, in the name of the precautionary principle, think 'that indisputable knowledge is required to act'. In contrast, the principle could have the opposite effect and help 'separate the decision to act from the certainty and indisputability of science. We don't know, but that doesn't stop us from acting and acting in a reasoned and rational manner.' However, by establishing scientific knowledge as a guide to action, the result is a very different approach. As Audrey Coreau *et al.* (2013) stressed:

> 'Under these conditions, the demand for ever-increasing certainty based on scientific knowledge, even when presented as a guarantee for taking more and better action, can, in practice, serve to take less action and postpone it while waiting for more in-depth expert assessments.'

The limits we just outlined, which ultimately result from the double equivocation mentioned above (that of science that knows everything about the issue and can dictate action), point to certain impasses in the knowledge-based strategic direction.

Science can undoubtedly point to the need for action (if nothing is done, biodiversity loss could lead to unpredictable results), but the transfer of scientific knowledge to expert appraisal responsible for guiding action implies a shift in perspective; it means exiting the realm of certainties and objective findings to include subjectivity. Edgar Morin's (1999) view on the matter is enlightening:

> 'As Dilthey revealed, explaining is not enough to understand. To explain is to use every objective means of knowledge, but these are insufficient to understand the subjective being. Human understanding comes when we feel and conceive of humans as subjects.'

In seeking to use science as the guide to action, the strategic direction adopted over-emphasised certain approaches. Despite all the rhetoric

about granting an essential role to the human and social sciences[37], the major international organisations are still, as the IUCN was in its early days, dominated by the life sciences. Research (Bennett *et al.*, 2016; Charvolin and Ollivier, 2017; Timpte *et al.*, 2018) thus stressed the still strong domination of life and conservation sciences and biologists in the expert panels (IPBES) selected in 2015. This was also emphasised by Marie Roué, anthropologist and IPBES member (2015):

> 'Short of a critical mass of experts in the social sciences, the IPBES is not in a position of interdisciplinarity, which is a first limitation.'

A team of German and British political scientists and geographers has demonstrated the apparent imbalance in the composition of the IPBES expert panel (Figure 11):

> 'About 84% of the nominations were natural scientists as well as 80% of the selected 153 experts. The share of social scientists was very low (only 4%), being the same for both nominated experts and selected experts.' (Timpte *et al.*, 2018)

Here is another example. In France, the French Biodiversity Agency (AFB) scientific committee comprised twenty-two members in 2018, including only two (less than 10%) members from the social sciences. It is now called the OFB with a scientific committee of twenty-five members, five of whom are from the social sciences, i.e. 20%, which reflects a slow pace of change. Good intentions are apparently to no avail (or not much). The composition of these institutions reflects a more or less conscious hierarchisation of the sciences, based primarily on the idea that there is, on the one hand, objective knowledge (and therefore 'easily' usable) and, on the other, disciplines whose relevance is relative and not obvious:

> 'The value of the range of social science methods (e.g. qualitative, quantitative, spatial, planning, evaluative, historical, meta-analytical, arts-based, and participatory methods) and related analytical techniques may not be immediately apparent to natural scientists, practitioners, or policy makers.' (Bennett *et al.*, 2016)

This undoubtedly sows the seeds of a drift towards a formatted science to respond to political demand and provide the necessary justification for

37. The Lake Success Conference (1949) showed that the IUPN initially envisaged a genuinely multidisciplinary approach, termed 'human ecology'.

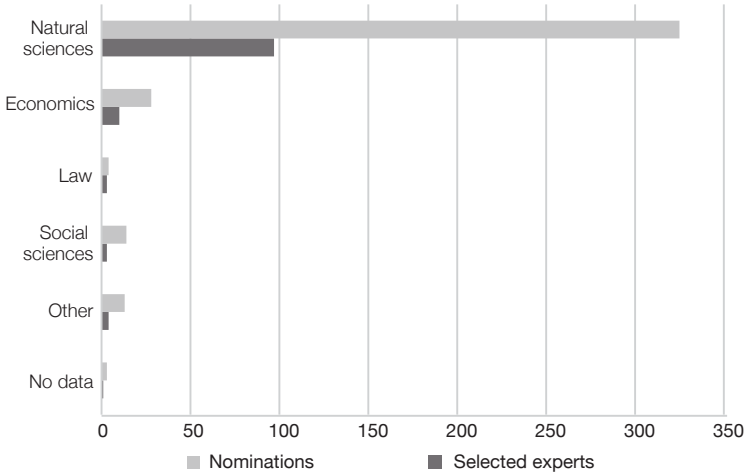

Figure 11. Proportion of IPBES experts by discipline (source: Timpte *et al.*, 2018).

action. Still, it is less equipped to deal with the uncertainty of knowledge and the diversity of social situations regarding the many possible connections to living things. All too often viewed as subjective and, therefore, relative and debatable, social sciences research, which highlights the diversity and subjectivity of these connections to living things, is marginalised by official bodies. The point here is not to call for a 'quota' of humanities and social sciences researchers but to emphasise that if these disciplines are reduced to a bare minimum, they will hardly be able to enrich the prevailing diagnosis with their contributions.

This tendency to overemphasise specific disciplinary fields maintains and even reinforces what Edgar Morin (1999) decried, namely 'the partitioning of disciplines [which] makes it impossible to grasp "that which is woven together", i.e. "complex", in the original meaning of the term'. Quoting Aurelio Peccei and Daisaku Ikeda, Edgar Morin observed that:

> 'The reductionist approach that relies on a single set of factors to solve all the problems posed by the multifaceted crisis we are currently experiencing is less a solution than the problem itself.'

Knowledge is not only science

Both ethnologists and anthropologists remind us that scientific knowledge is only one means, among others, of understanding our relationship

to living things. This objective rationality[38] only makes sense in naturalist ontology as evoked by Philippe Descola (2008); it has no relevance to animist peoples, for whom the exteriority of nature is quite simply inconceivable:

> 'For naturalism is only one of many ways of organising the world, that is to say, of operating identifications by distributing qualities to existing entities based on the various possibilities of imputing to another indeterminate entity a physicality and an interiority analogous or dissimilar to those experienced by every human being.'

Once we accept that the 'Western' conception of the world is not the only one, that it is not 'superior', scientific knowledge can no longer be the benchmark for our knowledge of and relationship with living things. Leaving aside other ontologies, it is enough to state the obvious: that our knowledge of the world also comes through channels other than those of the intellect.

Our relation to the world is also shaped (is first and foremost shaped?) by emotions and feelings that form an experience and contribute to our knowledge of the world around us. Rather than irrationality, it is a form of subjective rationality (in the sense that it involves a subject who is capable of choice, reasoning and personal 'values') which complements and modifies the point of view put forth by scientific knowledge, namely objective rationality (in the sense that it considers the world as objects of study). Analysing Paul Ricœur's and Hans Jonas's work, philosopher Pierre-Olivier Monteil (2018) outlined the three registers that condition our relation to the world: the tangible, feelings and meaning. The concept of biophilia, developed by Erich Fromm in 1964 ('love of living systems') and later taken up by Edward O. Wilson in 1984 ('our innate tendency to focus upon life and life-like forms'), if we are willing to disconnect it from its genetic background, underlines an essential dimension of the link to living things that directly involves the emotional domain. Biophilia, but also biophobia (Simaika and Samways, 2010), express these subjective feelings that are part of everyone's experience of the living world and which also largely guide our actions and perceptions (Riboulot-Chetrit

38. Objective here in the sense used by Edgar Morin when referring to science, 'Objective knowledge, which is its ideal, has led to ruling out subjectivity, i.e. the affective part inherent in every observer, every scientist, but it has also entailed the elimination of the subject, i.e., the being who conceives and knows.' (Morin, 2007)

et al., 2018). In this sense, Alizé Berthier *et al.* (2017) showed that the relationship of city dwellers to birds is, first and foremost, emotional and sentimental.

One of the contributions of reconciliation ecology (Fleury and Prévot-Julliard, 2012) is that it revealed the link between experience, contact with the natural elements and the readiness to act to safeguard them. Recognising that 'knowledge is clearly not enough. Experience is required …', ecology of reconciliation shows the importance of this aspect. In line with the work of Peter Khan *et al.* (2002) who posited that the loss of connection with nature as a result of urbanisation, lifestyle changes and the degradation of ecosystems is one of the major causes of the current crisis; this approach underlines, supported by extensive research, the benefits that result from experiencing nature and the subsequent concern to preserve it.

This experience of nature can also be mediated through books, films and cartoons, all of which are essential vectors of emotion and attachment. Yet, here again, experience tends to fade away, judging by the work of Anne-Caroline Prévot-Julliard *et al.* (2015) who pointed to the drop in nature scenes in Disney cartoons over the last decades. Rehabilitating experience, emotions and subjectivity in this relationship to nature enables us to break away from an approach that places humans in a position of mastery (scientific and technical) and to open up new perspectives for knowledge and action. In line with the work of Paul Ricœur, Pierre-Olivier Monteil (2018) states the following:

> 'In the order of knowledge, techno-scientific objectivity substitutes objective physical properties for the sensible qualities of nature. In the order of action, exacerbated anthropocentrism conceives of living things as being placed at the disposal of humans, leading to a generalised instrumentalisation of nature. But this conception is a fiction that anaesthetises our bodily experience of the world and tends to render it insensitive and invisible to us—except in the form of a problem that calls for new technical solutions.'

We believe this last sentence is essential. It illustrates the 'technicist' drift of an approach based on a problem and solutions, identified and defined by scientists and experts and then applied by politicians. This approach to living things leads to reasoning in terms of financial compensation for the damage caused to livestock by predators, when the relationship between farmers and their animals is far more than economic. This 'techno-scientific' rationale results in the definition of theoretical needs without

pausing to identify the expectations, desires and wishes of individuals and groups; expectations that, more often than not, depend on the context, the place and what constitutes real life.

Subjectivity also demands that we consider the territorial contexts where our relationships to biodiversity operate. While the concept of biodiversity may be approached as a scientific object (albeit with the severe difficulties we mentioned), the relationship to biodiversity, considered as a whole, is impossible. In this sense, Richard Raymond (2015) emphasised that:

> 'In fact, the stakeholders in an area are always in contact with one part, and only one part, of this system [biodiversity]. And, locally, these parts are always different.'

Failure to consider these contexts also leads to technical approaches deemed inappropriate by many authors in the human and social sciences. Mathilde Canard *et al.* (2017) showed the contradictions of a non-contextualised application of the green-blue infrastructure in the Occitanie region. It makes no sense to apply the same policy, on the pretext of maintaining ecological continuity, to areas as different as the peri-urban fringes of southern Toulouse (the lower Lèze valley), the cereal-growing areas of the Salat valley and the mountainous areas of the Neste valley. The same policy cannot be applied to such different ecological, historical and social contexts. Ultimately, each territory is a unique meeting place for humans and non-humans. Ecological contexts and processes are specific to each territory, as is how territorial stakeholders perceive and assess them. This was brilliantly analysed by Isabelle Mauz (2002) concerning the cohabitation of man and animal in the Alps, in mentioning the animal's 'rightful place', which varies in space and time and results from a social construction in changing ecological conditions. Failure to take this territorial dimension into account often renders the solutions ineffective.

The need to contextualise refers once again to the subjective dimension mentioned earlier. Drawing on several case studies, Léa Sébastien (2016) thus highlighted the diversity of forms (heritage, sentimental, nostalgic, sacred) and 'objects' (trees, rivers, birds, etc.) of people's attachment to their place of residence. She also pointed to the ensuing potential for engagement (and conflict at times).

It is this same attachment that we had analysed on the Millevaches plateau (Brédif *et al.*, 2017). We explained that a policy merely applying solutions that present themselves as scientific will always come up against the historical depth, ecological, and social complexity of the territories in question.

Environmental education is one of the cornerstones of international biodiversity policies (Sigaut, 2011). Since the Rio Conference, the focus has been on education for sustainable development from a very top-down and instrumental perspective.
In this context, the emergence of the biodiversity issue remains highly dependent on sustainable development and this instrumental approach. Serge Franc *et al.* (2013), speaking French teaching programmes, mentioned that:

> 'These programmes highlight two fundamental dimensions of education concerning biodiversity: the knowledge required and the behaviours expected. Biodiversity-related knowledge is mainly confined to the bio-ecological register and, to a lesser extent, biodiversity management.'

The emotional and sensitive dimension of the relationship to living things is largely ignored:

> 'The knowledge set out in the official position on the relationship between man and the environment focuses mainly on humans' threatening and destructive role. … French curricula emphasise the necessary academic knowledge. … In fact, the targeted behaviours are more of a behaviourist[39] than reflective nature. Yet, curriculum designers have defined the behaviour expected of students regarding the knowledge imparted as civic-minded and responsible.'

Knowledge centred on bio-ecological aspects, prescriptive approach, but also, thirdly and importantly, a mostly individual approach (Chawla and Cushing, 2007): biodiversity education is based on 'a positivist, behaviourist and individualist paradigm' (Robottom and Hart, 1995). Such education is rooted in 'the knowledge of experts who identify problems, develop solutions and share best practices' (Fortin-Debart and Girault, 2006). It spotlights the impacts of individual behaviour by looking at the environment primarily from the angle of problems. Lastly, it is based on an assumption, which we now know is incorrect, that a better scientific understanding of nature will necessarily lead to virtuous behaviour, whereas a lot of research shows that the emotional vector, experience and a direct link with nature are far more significant stimuli (see Jacques Tassin's 2020 book, *Pour une écologie du sensible*). It implicitly aims to make children the vectors of better behaviour, 'making children the means and not the end' (Morel, 2018). The French 'model of public education'

39. In the sense of learning primarily focused on conditioning.

studied by Michel Callon (1998) has not disappeared, and it 'still structures the prevailing ways of thinking and doing of scientists, engineers and politicians'.

Perverse effects with far-reaching consequences

In addition to the limitations mentioned above, the perverse effects of such a strategic direction and the methods of action it advocates have been evoked by many researchers, notably from the human and social sciences (political scientists, historians and philosophers in particular). The methods of action employed (giving pride of place to the disciplines of ecology, biology and economics, the role of experts and criticism of political inaction) have far-reaching consequences, not only for the success of the action in question but also for science itself and politics.

Such an approach bestows on experts, the 'knowers', a preeminent role over the other players. At best, the latter should be consulted or merely informed and educated. In the final analysis, the driving forces of action are the measures to be taken rather than the mobilisation of subjects (individual and collective).

Yet, such an orientation confuses two kinds of issues: the 'knowledge' issue and the 'action' issue (Brédif, 2021). As a result, it is possible to consider the erosion of biodiversity or climate change as scientific issues. The point is to view them as genuine phenomena that should be monitored and characterised by the various sciences, and why not whose possible developments and consequences these sciences must predict. Hence, solving a problem involves shedding light on said phenomenon, its origins, foreseeable developments and potential consequences. In this sense, the aim of the problem-solving approach is knowledge. The situation is different, however, when the question becomes one of action: the theoretical issue becomes an issue of action when one or more people feel that the gap between the desired situation and the actual or observed condition is not, actually or potentially, satisfactory. No problem exists independently of perception or the feeling of a problem (Brédif, 2016).

The subjective aspect thus becomes essential not only to decide if a problem is a problem of action but, above all, to consider the means to solve it. By failing to make a clear distinction between the two types of problem, by focusing on the 'objective' aspect, we are depriving ourselves of the levers for action afforded by the subjective and contextualised dimension of the problem. In doing so, priority is given to one form of intelligence

without consideration for the fact that, at the same time, another is devalued, as stressed by Henry Ollagnon (1989):

> 'Several forms of intelligence express themselves. … One, the intuitive and pragmatic intelligence, will favour the complexity in "what is locally meaningful" and close meaning, with no pretence of going beyond the local, whereas the other, the universalist intelligence, will give priority to what is universally significant, comparable, has universal meaning in the local context, to the detriment of local complexity.'

Therefore, the problem of action cannot be understood without the emotional and relational dimensions underpinning all commitments. Ruling out such levers considerably narrows the field of action and its efficacy. The action becomes a programme; it is not strategic, as Edgar Morin (1999) argued:

> 'Strategy is the opposite of a programme, although it may include programmed elements. A programme is the prior determination of a sequence of actions to achieve a goal. A programme is efficient under stable outside conditions that can be determined with certainty. But the slightest disturbance in these conditions disrupts the execution of the programme and brings it to a halt. … The strategy … modifies its action according to the information collected and the hazards encountered. Our entire education leans towards the programme while life demands strategy of us.'

While the term 'strategy' is often used in international texts (Aichi biodiversity strategic plan, national and local biodiversity strategies), the rationale adopted by international bodies is more akin to a programme. Often, the purpose is to set targets (such as the twenty Aichi Targets) to draw up a list of actions to implement for a ten-year period, followed by a final assessment. When the programme does not meet its targets, when, summit after summit, a gap appears between the targets and achievements, a feeling of failure and fatality emerges, which is not conducive to mobilisation.

The responsibility assigned to science to warn of the risks that current developments could pose for the planet due to global warming and biodiversity loss is also fraught with consequences and potentially perverse effects. In becoming whistleblowers, scientists also become communicators; to be heard, the message must be simple and impactful. This has sometimes resulted in messages which, while forceful, were nonetheless far removed from scientific rigour. These may be widely circulated, but ultimately, they may undermine all the efforts undertaken.

> 'In 2010, at a round table discussion I was attending, the current President of the IUCN, citing the UN as his source, said that the rate of species extinction was a thousand times higher than "normal". How can we believe those who repeat estimations produced by such and such scientists as a result of acrobatic calculations and extrapolations?' (Blandin, 2014)

Although several scientific studies (Pimm *et al.*, 2014; De Vos *et al.*, 2015) have supported such extrapolations; their accuracy and relevance are somewhat limited. Yet, they are broadly circulated in the official documents on the subject.

Christian Lévêque (2017) tackled one of the other key figures in the current catastrophe, one which is also widely reported: the number of species threatened with extinction in the coming decades:

> '*Nature*, always on the hunt for advertising stunts, published an article in 2004 stating that one million animal and plant species could disappear by 2050 due to the forecasted climate changes. Quite a statement, given that the inventory of biological diversity is still very sketchy and that the models cannot provide us with adequate information on the local consequences of climate change. This is science for show, intellectual speculation cloaked in the trappings of science.'

To say the least, this is a strong attack, which does not mean it is inappropriate, as there are many examples of simplification. The warning message being sent out, in the hope that it might lead to awareness and action, is fraught with severe risks. First, it suggests that the future is known and written and that the chances of escaping it are slim. As Antoine Chollet and Romain Felli (2015), two political scientists from the University of Lausanne, argued:

> 'Catastrophism is based on a particular conception of time, consisting of determinism and a future which, on the one hand, has lost all form of unpredictability and, on the other, has colonised the present.'

Such catastrophism would be justified by the urgent nature of the decisions to be made and the risks of inaction. As pointed out by the political scientist Luc Semal (2019), this is nothing new to ecological rhetoric. It draws mainly on research relating to collapse, of which Jared Diamond was one of the most notable exponents. In warning about a possible collapse of our societies and, more radically, of humanity, this catastrophist rhetoric aims to trigger a feeling of fear, an emotion that would inspire engagement. It also aims to communicate that collapse is already underway and that time is running out:

> 'Consequently, the challenge is not thinking about the long term (because this we already do through the prism of the myth of development, techno-scientific progress or continuous growth) but instead thinking about the countdown.' (Semal, 2019)

The theme of urgency can certainly generate commitment, as demonstrated today by the recommendations of certain 'collapsologists' (Servigne *et al.*, 2018). It could also pave the way to 'submissiveness based on a policy of fear' (Chollet and Felli, 2015). Thus proclaimed, it calls for robust, even authoritarian solutions that are yet to be determined but are potentially dangerous for democracy. In such a case, the risk is that science will serve an authoritarian political project.

In this sense, the author of many ground-breaking ideas, the philosopher Hans Jonas, discussed the need for a 'benevolent tyranny' (1979). While concern for the future can be a source of reflection and action, and the feeling of fragility described by Paul Ricœur (1992) can point the way to caring for the living realm, the issue of fear and urgency precipitates the search for strong and immediate solutions to be provided through scientific knowledge. It precludes processes that are too slow in light of the little time available and calls for radical solutions.

Yet the outcome of this approach, in terms of mobilisation, is debatable. First, it introduces what the psychologist Steven Pinker (2019) has called a 'negativity bias':

> 'And so, repeating a negative message will imprint it on our memory and lead us to believe that the world is going to the dogs. … This negativity bias drives us to fatalism, to think that any effort to improve the world is a waste of time because all the steps that have already been made in this direction have only made the situation worse. Worse still, this bias can also lead us to radicalism, to believe that if all our institutions have failed, there is no point in trying to reform them.'

All too often, this negativity bias minimises the efforts made so far, which are implicitly judged ineffective; it contributes to undermining the credibility of the day-to-day efforts carried out by many players over the decades. As such, it contributes to the divide that historians of science Christian Bonneuil and Jean-Baptiste Fressoz had decried in 2013:

> 'On one hand, we radically transform nature while on the other, we proclaim the impossibility of changing society.'

Because this foretold catastrophe is global, it often refers to a globalising 'we': we humans are responsible for this foretold or ongoing catastrophe.

The recent emergence of the notion of the Anthropocene is part of this approach, which encompasses human beings in an undifferentiated entity that 'produces a powerful unifying effect, in other words, the removal of political division' (Chollet and Felli, 2015). Facing the (obviously) guilty 'we', the individual 'I' is disarmed and forced to act alone by applying all the 'responsible eco-actions' he is bombarded with to educate him.

> 'On World Environment Day 2015, the United Nations Environment Programme (UNEP) launched the hashtag #just1thing on Twitter, listing the small gestures that everyone can do to save the planet. At its most ridiculous, the UNEP seriously suggested that as an 'ecological gesture', people should travel by plane with an electronic ticket rather than a paper ticket …' (Chollet and Felli, 2015)

The whistleblowing role attributed to scientists (and claimed by some) is not without potentially dangerous effects. Focusing on the theme of disaster denies us the opportunity to see the results of the actions carried out, the efforts and initiatives of the many players involved, and that there are groups and ongoing processes initiating change. At the same time, there is a 'communication dissonance', as described by the sociologist Lionel Scotto d'Apollonia (2016), which 'reflects the tension to which "whistleblowers" are subjected, between the ethic of "conviction" (Weber, 1965) (speaking out about science) and the ethic of "responsibility" (speaking out about the risk they perceive)'.

Viewing scientific knowledge as the guide for political action and citizen mobilisation perpetuates the confusion between science and expertise, which we believe is still present in prominent international organisations. The creation of the IPBES at the international level illustrates this. Although, unlike the IPCC, it is not explicitly tasked with formulating public policy recommendations to Member States, its mission includes both a scientific dimension (carrying out assessments) and an expertise dimension (supporting the development and implementation of policies). Its purpose is not only to advance knowledge but also to guide action. The IPBES subtitle 'Science and Policy for People and Nature' encapsulates the approach: know (science), guide action (policy) and circulate ideas (people). As Marie Hrabanski and Denis Pesche highlighted (2017):

> 'The IPBES's ambition is to become a reference for both scientists and decision-makers, to enable the better coordination of the players involved in this network of regimes, and thereby to promote the coherence of recommended policies.'

As the complexity of scientific research cannot be transposed as it is, more and more frequent use is being made of indicators that are sometimes produced by scientists but more often by experts from significant institutions or NGOs (the Living Planet Index produced by the WWF; the Ecological Footprint taken from a scientific article but then developed by a *think tank*; the DSR indicator[40] produced by the Organisation for Economic Co-operation and Development, OECD, etc.), as has been the case for a long time in economics.

Of course, scientists have been producing indicators for a long time. In biogeography, the Gaussen (number of dry months) and Emberger (rainfall-thermal quotient) indicators have long been used as references to determine ecological limits. They also contributed to the scientific debate, although they were not intended to lead to specific courses of action. However, indicators are now used and, in a way, exploited as the assurance of the scientific nature and objectivity of certain political decisions: they exist to certify that a threshold or a rate has been crossed, that action should be taken and that it should be done 'objectively'. Yet, an indicator in itself indicates nothing. It is all a question of interpretation. Denis Couvet *et al.* (2008), researchers at the MNHN, clearly demonstrated this:

> 'One of France's ten environmental indicators, the cost of environmental protection, appears to be a poor indicator because it distorts the issues at stake by representing environmental protection as a luxury rather than an investment. This is because it measures the immediate costs of environmental protection, which are growing faster than the GDP (www.ifen.fr) and overlooks indirect economic benefits.'

Corrado Battisti and Longino Contoli (2011) are of the same opinion:

> 'A lack of critical analysis of the processes that are the source of values of a particular diversity index would drive the unaware technicians to plan strategies that could fail in their objectives.'

Scientists are often the victims, sometimes willing, of their work being exploited by expert panels to create 'objective' indicators.

The problem is not producing indicators but accepting that they can be used to judge whether or not a policy is well founded. As geographers Hervé Brédif and Paul Arnould (2004) pointed out:

40. Driving force—State—response.

> 'Criteria and indicators are presented as a quasi-necessity; they seem to result from a simple, neutral and perfectly rational definition process, whereas they result from a "translation' process".'

Christian Lévêque *et al.* (2010) condemned this same drift towards the instrumentalisation of scientific knowledge when they criticised the notion of a 'good ecological state' used in certain public policies, which is ultimately very difficult to define, not to say impossible.

Is there not also a risk that these 'official' institutions create the illusion of science speaking with 'one voice' (Coreau *et al.*, 2013), to the detriment of essential questions and knowledge other than scientific and expert knowledge, and of the processes for sharing this knowledge, in particular, 'so-called lay knowledge, produced by "amateurs" in naturalist organisations, for example, [which] is linked to a specific commitment based on sensitive and familiar connections to an environment, local or personal ties, dynamic social links within a group, practical knowledge and the values that structure them' (Rodriguez *et al.*, 2018). Current research, specifically in the social sciences, argued that another form of expertise is possible:

> 'Expert appraisal must be collective, adversarial and include minority opinions, and procedures must guarantee transparency and independence. Unlike the former model, which sought to "contain and reduce incertitude", the procedural model is based on "making incertitude visible", thereby restoring public decision-making to its rightful role.' (Granjou, 2003)

The role of guide assigned to scientific knowledge and experts has resulted in the delegitimisation of politics, often accused of inaction even though the evidence exists. Such rhetoric is based on a simplistic approach to the relationship between science and politics. Philosopher and historian Marcel Gauchet (2011) appropriately pointed to 'the intrinsic vulnerability of the scientific discourse when asked to put together an overall picture using ultra specialised knowledge, with all the incertitude this entails. … The main point is that scientific information can only really win people over if it is coupled with a political discourse that explicates it by providing the keys to its collective use. Otherwise, it is no more than a variable that political decision-makers are free to consider. Yet, the sciences do not have the resources to produce such discourse independently. … Their authority, which is tremendous in our world, has no hold on everyday existence.'

This means that scientific knowledge can in no way claim to dictate politics, that in the political order, it is only one form of knowledge among others, and that, should it claim (or imply) to hold the solution, it would lose credibility (Gauchet, 2011).
Political activity does not easily tolerate arguments of authority, as Bruno Latour (2010) highlighted:

> 'If you start by saying, "We are going to divide the assembly between those who have irrefutable facts and those who debate", nothing will happen. It is the very negation of political activity.'

Ultimately, the potential risk of viewing science and its results, the experts and their array of indicators, as the bearers of truth is the very negation of politics. However, international bodies have been aware of this risk for several years. No meeting, text or programme fails to include the necessary participation of citizens, peoples and minorities. Participation, which is supposed to reinstate the political dimension of the issue, has become the mandatory benchmark for any biodiversity initiative. The IPBES constantly stresses the importance of these processes and the role of indigenous knowledge and stakeholders. Nevertheless, one can question the reality of such discourse: participation focuses primarily on access to and sharing of benefits and, therefore, on a utilitarian approach far from reflecting a shared approach. Participation is often designed, particularly by major international bodies, to achieve social acceptability. As a result, the basic principle of empowering local populations is being undermined. Science historian Dominique Pestré (2011) emphasised this slippage when he stated that:

> 'Public participation in decision-making processes, when it is in the hands of powerful institutions dedicated to promoting technologies, will quickly shift from being a tool for empowerment and democratisation to a device for managing dissent, an avoidance technology, or even simply a tool for bringing people to accept decisions that have already been made.'

When scientific knowledge is deemed superior and therefore endowed with legitimacy that is, if not exclusive, at least in part superior to that of other forms of knowledge, and when expertise is considered to be the translation of this science, there is a risk that the dialogue processes will be misused. Thus devised, participation becomes, following Sherry R. Arnstein's diagram (1969), mere manipulation.

Criticism review

As with the previous category (Protect), a rapid assessment of the criticisms of the use of scientific knowledge helps establish a hierarchy of their significance and degree of radicalism.

The first set of comments is primarily intended to qualify the assertion that science alone would be capable of stating what is and, above all, what needs to be done. Ecologists recognise that they are not currently in a position to draw up an exhaustive assessment of the state of biodiversity and that there are still many issues to be resolved, which supports the knowledge effort but also highlights its current limitations. Together with authors from the social sciences (sociologists, political scientists, philosophers of science), they also emphasise the relativity of scientific knowledge at a given time for the obvious reason that science evolves and can only progress by debating established knowledge. Hence, science cannot claim to provide irrefutable knowledge; instead, more modestly (and this is essential), it reflects the state of knowledge at a given moment. Philosophers and historians of science also point to the fact that no science may be isolated from the context in which it progresses. And it is, once again, environmental scientists who have warned against systematically transcribing scientific knowledge into action. Fundamentally, the complexity of living things remains in the realm of incertitude, especially when prospection is involved. Hence, the issue is no longer the application of 'instructions for action' but rather the political choices made by all stakeholders. The latter, including scientists, are the only ones in a position to decide what does or does not constitute a problem and what should or should not be done. Finally, these comments do not discredit the efforts to improve scientific knowledge of the living world, which remains necessary. Instead, they aim to put it back in its rightful place, which is to inform action without claiming to become the sole reference.

The debate becomes more radical when many authors, including ethnologists, anthropologists and philosophers, consider that objective rationality is far from covering the field of knowledge. In this instance, criticism is sharper insofar as it contests a posture that places humans as the masters and holders of solutions (mainly technical) and who 'objectify' all living things. In contrast, for these authors, the relationship to living things is fundamentally one of subjectivity. These authors stress that parallel to scientific rationality, there is a form of subjective rationality that provides knowledge and may also be a vital catalyst for engagement.

This subjective rationality is not solely the realm of individuals; it is also expressed through the diversity of social groups, cultural environments and territories studied, particularly by ethnologists, geographers and sociologists.
The same debate affects education projects, with advocates of an education that instils knowledge and supporters of cognitive learning that is more open to the sensory and subjective dimensions.
Together, these criticisms lead to debate, not the importance of scientific knowledge, which nobody questions, but its ability to encompass the triptych: knowledge-problem-solution.
Critics go further, however, in addressing the dangers of the 'illusion' of an expert science that should be applied through political decisions. The criticism becomes radical, especially from political scientists, philosophers and historians who perceive a fundamental risk in this approach, both for the credibility of science and the legitimacy of politics.

Valuing and stimulating at the risk of monetising

The debate on monetary valuation can be grouped around several major issues that have been of concern to the scientific community (and more broadly to the institutions responsible for the subject) for the last thirty years or so:
– The first set of questions regards the relevance and merits of an approach that focuses on services and valuation. It gravitates around a fundamental interrogation: should a monetary value be assigned to living things?
– The second set concerns this approach's relevance and capacity to account for the living world and its characteristics fully.
– Finally, the third set of questions relates to the more or less direct and perceived consequences of such an approach: the motivations it advances and the political processes to which it leads.
The scope of the debates explains the diversity of the points of view expressed and the disciplinary fields involved. Quite logically, philosophers, economists and lawyers have primarily focused on the first question, with contrasting viewpoints for each discipline. The ecologists have been more active on the second aspect, while the social sciences and political science have concentrated on the consequences of such an approach, particularly the political consequences.

Between radical criticism and consequentialist approach

The reluctance and opposition to putting a monetary value on biodiversity are based on two sets of considerations.

The first concerns the very definition of biodiversity envisaged solely in the scientific sense, that of a property of living systems. When focusing exclusively on this dimension of biodiversity, monetary valuation becomes meaningless. Jean-Michel Salles *et al.* (2016) emphasised that: 'Biodiversity is a property of ecosystems and therefore has no price'. Putting a price on something that is not a commodity but an attribute, a feature of natural entities (and not just ecosystems) becomes simply impossible: it is possible to put a price on a forest but not on the diversity of the entities that make it up, nor on the interactions between these entities. The contradiction becomes apparent when ascribing an 'intrinsic value' to what is merely a changing feature of living systems over time.

Therefore, putting a value on biodiversity implies establishing it as an entity, asset, or resource. This has evidently been the dominant position since the Rio Conference (1992), with its emphasis on sustainable use and access to resources. This position gives rise to a second set of oppositions to valuation. One is a radical opposition of an ethical nature, which considers that assigning a price to something is tantamount to thinking that it can be traded and, therefore, to viewing it as relative, non-essential. While the idea is not new (it is already found in Kant), it was recently expressed by economists such as Sacha Bourgeois-Gironde, Yves Doazan and Charles Figuières in a 2011 article:

> 'Prices divide the world into two categories: market goods and other things. While the former contains vulgar things, the latter can include noble, sacred things. Putting a price on something or arguing that something is priceless defines the boundary between our intangible values and what we are prepared to compromise on.'

To put a price on the diversity of life is to consider that this diversity can be exchanged for a sum of money and that it is, therefore, not so essential. Other authors also stress that biodiversity results from the diversification of living organisms over billions of years and that it is the fruit of a history that cannot be priced. As Marc-André Selosse (2017), a professor at the MNHN, pointed out: 'The value of biodiversity is that of the time needed to generate it: irreplaceable and invaluable in the short term.'

The diversification processes of living organisms generate functional relationships between the various components of biodiversity. Consequently,

biodiversity cannot be divided. Now, the indivisible nature of the living realm is incompatible with its monetisation:

> 'For biodiversity to be given a monetary value and a market price, it must be codified and standardised, broken down and reassembled.' (Tordjman and Boisvert, 2012)

The problem has been identified by legal experts (Camproux-Duffrène, 2009), who agree with certain ecologists when they argue that 'it is impossible to think of biodiversity as a sum of juxtaposed and isolated elements' (Devictor, 2014).

All these arguments converge to emphasise that a monetary approach to biodiversity cannot be envisaged without depriving it of its essential attributes. Some ethical arguments should be added to these radical criticisms:

– Setting a value on biodiversity implies taking an anthropocentric viewpoint in which humans are considered the central entity; those who evaluate because they are, in a way, the recipients of this biodiversity. However, although biodiversity as the outcome of a process undoubtedly involves humans, this does not mean that humans are its sole justification or the only condition for its continuation (Brédif, 2016).

– Even envisaged as a commodity, biodiversity should be viewed as a heritage which must be passed down to future generations (Maris and Revéret, 2009). In principle, such a 'bequest value' precludes any attack on this diversity and, thereby, any process based on market value that would allow a loss to be made. As species are neither replaceable nor reproducible, losing one is an irreversible process that runs counter to the duty of transmission.

Through these criticisms emerges a radical questioning of the meaning and value (not just monetary) that we assign to the diversity of living things, the place of man in diversifying living things, and the possibility of appropriating these living things.

The debate surrounding the impossibility of valuing life forms was not lost on the authors who opted for this strategic direction. Reference to the intrinsic value of biodiversity in most of the literature on the valuation of living things shows that, for these authors as well, living things cannot be reduced to their monetary value alone. In the minds of the authors of the Millennium Ecosystem Assessment (MEA) or the TEEB report, the intrinsic value represents a dimension of biodiversity that is irreducible to any appraisal and should be considered an 'end in itself'.

> 'In fact, the MEA does not place monetary values on ecosystem services and even the more economically focused TEEB study accepts the existence of multiple and non-commensurable value dimensions stating that for specific types of ecosystem services, monetisation is inadequate or even misleading.' (Jax *et al.*, 2013)

Consequently, the contradiction is perceptible since, as mentioned in the TEEB report (2010), the point is to 'estimate the inestimable'. Thus, the very proponents of valuation implicitly recognise the 'moral' limits inherent in evaluating living things. Building on these ideas, however, some authors stress what they consider an essential clarification of the objective pursued. According to the economist Jean-Michel Salles, co-author of the report *Approche économique de la biodiversité et des services liés aux écosystèmes – contribution à la décision publique* (Bielsa *et al.*, 2009; An economic approach to biodiversity and ecosystem services—a contribution to public decision-making), there was no question of putting a monetary value on biodiversity "with a view to selling it to anyone", but rather to estimate its economic value, defined as 'its capacity to contribute to people's well-being because it is useful'. In his wake, many authors (Ribière, 2013) stressed that putting a price on something does not necessarily imply being in favour of its commodification. Assigning a value does not necessarily mean authorising a transaction. Henceforth, the stated purpose was not to create a biodiversity market. These authors also show that the refusal to evaluate results in the refusal to choose between several options and that this refusal has a cost. As Georges Ribière (2013) noted:

> 'Not so long ago, the value of ecosystem services was only appreciated when they were declining. … However, the "economic invisibility" of the environment tends to negate the values of biodiversity and, as a result, can lead to an objective imbalance in the decision-making factors of public and private players.'

Valuation is, therefore, based on a 'consequentialist' perspective, which judges an action's relevance and value in terms of its results. Speaking about the moral objections raised by the valuation of living things, Sacha Bourgeois-Gironde *et al.* (2011) stressed the following:

> 'For we are talking about situations where choices have to be made, one way or another. … Refusing to arbitrate means opting for a real-time scenario, which we know is unfavourable to nature. … We should not forget that moral repugnance has a cost.'
>
> This shows that the proponents of monetary valuation have taken a utilitarian approach. There are several arguments supporting their approach, which focuses above all on instrumental values.

First and foremost, valuation is part of an effort to understand better the services provided by the diversity of life forms. For example, well-known research has assessed the monetary value of pollination, the water purification costs avoided by diversifying ecosystems in New York, Berlin or around Vittel, the agronomic and health benefits of the genetic diversity of species, etc. Such studies now number in the thousands, and they testify to the importance of biodiversity in the economic and cultural life of societies, as well as for individual well-being:

> 'Economic valuation is used to highlight the benefits to humankind of protecting biodiversity. In this research, money is used only as a standard, a tool for demonstration.' (Hautereau-Boutonnet and Truilhé-Marengo, 2016)

To evaluate, including monetarily, would first and foremost meet a legitimate concern for knowledge and how to influence debates and decision-making processes by producing new arguments.

This knowledge, even if far removed from a purely utilitarian vision, becomes a tool for reflection, which can be used in action to engage in dialogue and compare the consequences of possible choices. The price assigned is not used directly to favour a transaction or to enable a market but to inform possible decisions (Brunet *et al.*, 2018). Another virtue ascribed to monetary valuation is that it provides elements of dialogue, common language (Guimont *et al.*, 2018) and argumentation.

In the first instance, valuation serves to alert us to the dangers resulting from the loss of living things. As emphasised by several authors:

> 'A major strength of the ecosystem services (ESS) concept is that it allows a succinct description of how human well-being depends on nature, showing that the neglect of such dependencies has negative consequences on human well-being and the economy.' (Jax *et al.*, 2013)

Here, knowledge is used to defend the cause at hand and to highlight the issues at stake and the need for action. In contributing to stress the importance and utility of nature, it adds another dimension to action in favour of biodiversity: the 'fight' is not solely to save species and ecosystems but also to bring benefits to society, thereby paving the way for positive mobilisation (Brunet *et al.*, 2018).

Hence, monetary valuation also becomes a tool for mobilising private and public funding:

> 'Some believe that by including species and natural environments in economic reasoning, it will be easier to convince the economic and political spheres of the benefits of nature conservation.' (Blandin, 2014)

This valuation effort has resulted in an accumulation of knowledge regarding the functioning and importance of ecosystems for human societies. The work carried out by the scientists has thus found its justification. This justification and the accompanying grants have certainly boosted the mobilisation of the scientific community (Barnaud et Antona, 2014). From an approach initially based on the need for knowledge, the focus has gradually shifted to a concept of valuation viewed not only as a strategic tool but also as an operational tool, as the legal expert Claire Etrillard (2016) clearly expressed:

> 'Nowadays, PES [payments for environmental services] appear as a timely and pragmatic avenue forward (Bureau, 2010) in that they can be used to develop remuneration for environmentally friendly practices.'

The position of the advocates of monetary valuation as an operational tool (and no longer merely as a knowledge or warning tool) is justified on the grounds of efficacy (Ring *et al.*, 2010).

To summarise, while valuation is not, in principle, opposed to essential moral values, and while it does not necessarily lead to the commercialisation of biodiversity, its primary justification is as an aid to action in favour of biodiversity. But behind this term of value assigned to biodiversity lurks a variety of meanings, the source of many ambiguities:

> 'Dictionaries typically define value as the property of something "estimable". However, they also reflect a diversity of possible meanings …: value as an appraisal of the importance of a thing/value as a quantified measure of the matter or usefulness of a thing (e.g. price)/value as a moral rule or reference (personal or collective).' (Fondation pour la recherche sur la biodiversité, 2013b)

However, it should be noted that the 'knowledge-warning-reflection' dimension has gradually given way to an operational dimension, illustrating, as expressed by Simon Dufour *et al.* (2016), 'the gradual shift over the last twenty years or so from the status of metaphor (mainly for educational purposes) to that of device (with a stronger operational focus)'. Consequently, the focus should now be put on this efficiency objective, claimed as essential by the advocates of monetary valuation.

A method of action with limited effectiveness

A recent major study by Sven Wunder *et al.* (2018), of seventy action programmes from around the world referenced in the scientific literature, highlighted the significant gap between theory and practice regarding

payments for environmental services. Their limited effectiveness can be notably explained by a generalised tendency towards simplification (lack of targeted objectives, absence of clear spatial delimitation, etc.). It can also be attributed to the lack of conditionality (sparse verification of actual achievements and few sanctions). Lastly, territorial targeting is often inadequate, making it challenging to identify and differentiate the efforts made by the various players.

This mitigated picture is far from unique. An international team led by Jan Börner involving researchers from several continents came to the following conclusion (2017):

> 'Many programs are also poorly aligned with pre-existing regulatory policies, ignore the potential for targeting payments, or fail to implement appropriate monitoring and sanctioning mechanisms and social safeguards. Often these programs were judged less successful by the authors of review studies, based on both qualitative and quantitative analyses, than programs that more closely adhered to "best practice" principles.'

In fact, these various reviews point to a gap between the principles of action and its concrete implementation. To meet conservation challenges, payments for environmental services call for the implementation of a complex contractual engineering process that involves challenges related to contract duration, results to be achieved in terms of environmental services and material support for these services (the underlying property) … (Etrillard, 2016).

Some authors also point to the difficulty of combining approaches with sometimes very different premises. While the stakeholders, on the whole, acknowledge that biodiversity is useful and has a certain value, thus allowing the beginnings of a dialogue, it is often much more challenging to get them to agree on concrete measures (Carnoye, 2018). Specifically, the ambiguity lies in the notion of value, whose meaning is polysemous without the necessary clarifications. The review carried out by the French Foundation for Biodiversity Research (2013c) clearly highlighted the vagueness surrounding the concept and its very different meanings concerning biodiversity.

> 'About biodiversity, then, it is clear that it may be a matter of understanding its importance for human societies, the monetary measure of its usefulness, its importance as a basis for cultural or social references, collective moral rules governing the relationships between societies and the environment.'

Failing a common understanding that would win support, this type of action ultimately appears to be no more than a 'lesser evil' (Semal and Guillet, 2017), as 'something worth trying where other approaches have failed' (Waylen and Martin-Ortega, 2018).

In light of the results discussed previously, it is essential to be cautious about the real impact of this strategic direction, in particular regarding its instruments (payments for environmental services, ARC[41], etc.), whose practical implementation is often far removed from the stated objectives.

An inability to grasp the dynamics of living things

Many authors, particularly ecologists and biologists, have pointed out that the monetary approach is ill-suited to the complexity and dynamics of living things and, consequently, not very operational. Several arguments have been put forward to demonstrate this relative inadequacy.

For many ecologists, the link between a service and a natural entity is debatable, if not impossible to appraise. While, following Bradley J. Cardinale *et al.* (2012), it is possible to recognise an overall correlation between the level of biodiversity and the supply of services, as soon as it comes to a precise valuation, many uncertainties emerge. For many services, insufficient data are available to perform a proper assessment. Bradley J. Cardinale *et al.* concurred with the observation made by other ecologists (Barnaud and Antona, 2014) regarding the incomplete nature of our scientific knowledge. The main difficulty arises from the fact that it is virtually impossible to establish a link between a service and a natural entity: no biological entity functions independently of those surrounding it, a fact underlined by the notion of 'ecomplex' (Blandin and Lamotte, 1988). Ergo, attributing a service to a particular ecosystem comes up against this relational functioning process. The quality of the water a river supplies depends on the state of the components of the whole catchment area. Consequently, it is often difficult to establish a simple relationship between the provision of a service and a given ecosystem. This complexity sometimes results in simplifications that no longer reflect the value of the diversity of living things and can be a source of confusion. Bradley J. Cardinale *et al.* (2012) hence criticised the Millennium Ecosystem Assessment conclusions regarding the risk of flooding, which would be

41. ARC: Avoid Reduce Compensation doctrine (see the first section).

lower the greater the biodiversity. Yet this conclusion is based on research that shows the impact of forest loss on the risk of flooding but says nothing of the role of the diversity of these forests concerning the risk. This would require demonstrating that a biodiversity-rich forest plays a more important role than a poor or monospecific forest. Similarly, by attributing a positive role to biodiversity in reducing urban heat islands, a hasty generalisation is being made, as there is currently no evidence to suggest that diversified urban vegetation is more effective than undiversified vegetation (Simon and Raymond, 2015).

The difficulty of assigning a value to biodiversity is even greater when the dynamic dimension of ecological systems and their partly unpredictable nature are factored in (Simon, 2018). A recent review measuring the responses of ecosystems to anthropogenic change concluded significantly that:

> 'The simulations reinforced our contention that global change biology needs to abandon the general expectation that system properties allow defining thresholds as a way to manage nature under global change. Rather, highly variable responses, even under weak pressures, suggest that "safe-operating spaces" are unlikely to be quantifiable.' (Hillebrand *et al.*, 2020)

The simplification of the living world inherent in these systems also contributes to setting an evolving reality in stone. Whether the measures adopted concern payments for environmental services or avoidance-reduction-compensation schemes, they generally involve a contract specifying both the remuneration price and the duration of the commitment. The project manager responsible for implementing these measures undertakes to maintain them sufficiently long to allow a positive biodiversity dynamic to compensate for the losses. However, in practice, it is impossible to match the duration of an infrastructure with the duration of the ecological restoration of the damage sustained. In some cases, the process of restoring the original state will take much longer than the span of the infrastructure itself, and no contract will be able to ensure that there is no ecological loss. Conversely, some measures are signed for such long periods (fifty years, a hundred years[42], or even for life, as can be the case in New Zealand or Denmark) that they are out of step with the dynamics of living organisms. For example, the species targeted by a measure may very well return to the

42. In Sweden, the measures adopted for the *Botniabanan* railway line span a hundred years.

site relatively quickly or disappear altogether during the lease agreed with no provision for adaptation in the contract. Monetary valuation means setting payment rules (or measurement obligations) over periods that are incompatible with population dynamics but also with the economic needs of contractors. One of the challenges of agri-environmental measures is that this framework is often considered too restrictive and insufficiently adaptable for farmers facing a highly uncertain economy.

This tendency to freeze reality is even more nonsensically evident with the approval of the patentability of living things in a market economy. As Gilles Hériard-Dubreuil and Julien Dewoghélaëre (2014) pointed out:

> 'Many patents filed by manufacturers concern genes that are never used and are sometimes present in nature. This enables industrialists to ban anyone else from using plants containing these patented genes.'

Some authors (Faith *et al.*, 2010), aware of the discrepancy between an appraisal made at a given point in time and the difficult-to-predict dynamics of living organisms, have proposed the idea of an 'evo-systemic service' to underline the complexity of freezing a service in time.

Integrating these temporal dynamics becomes even more complex when introducing the long-term, fundamentally linked to evolution. On this point, Virginie Maris (2011) highlighted the gap between short-term measures and long-term socio-ecological dynamics:

> 'It takes several centuries for an ancient forest to develop. The Crau coussouls are the legacy of thousands of years of pastoralism. Peat bogs shed light on the Iron Age, almost 3,000 years ago. Under no circumstances can the timeframe of compensation mechanisms by ecological restoration of natural environments, which at best envisage monitoring over one or two decades, accommodate the long-term nature of natural environments.'

Monetary valuation is, therefore, hardly compatible with the moral obligation to conserve biodiversity for future generations and to maintain a potential for evolution that remains largely unexplored. This touches on one of the fundamental ethical values of biodiversity: the bequest value. This contradiction has been emphasised by an international multidisciplinary team:

> 'Insurance values add a temporal dimension to the analysis by highlighting the importance of maintaining ecological conditions to secure ecosystem services flows over time in the face of disturbance and change, thereby preventing value myopia whereby actions are taken to achieve short-term gains at the expense of inducing losses in ecosystem resilience.' (Jax *et al.*, 2013)

Aware of the problem, economists have sought to account for this long-term dimension through the concept of 'option value'. However, as stressed by one of them, Jean-Michel Salles (2010):

> 'Calculating the value of a quasi-option would require a complete description of the scenarios associated with each option and an assessment of all their consequences. Obviously, this is not a realistic requirement.'

Ascribing a monetary value to biodiversity means largely ignoring the dynamic dimension of living things. It fundamentally reduces biodiversity to a stock of (more or less renewable) existing resources. In contrast, the teachings of ecology have insisted for several decades on the decisive importance of flows, interactions and connections.

A confusion between ecological and social matters

The ecosystem services concept fuels the confusion between ecological and social issues. Cécile Barnaud and Martine Antona (2014) have highlighted the difference that exists, even within the scientific community, between researchers who consider services only in terms of what is produced by ecosystems and those who include the human activities linked to ecosystems in these services. Some prefer using the ecosystem services concept, while others refer to environmental services. To take a simple example from the field of agriculture, a distinction should be made between the result of natural processes and human action. For advocates of the social approach, an agricultural product can be likened to a service provided by biodiversity, although it is co-produced by society and nature, whereas supporters of a more ecological approach tend to restrict services to natural, directly harvestable products.

This is one of the fundamental distinctions between ecosystem functions and services. Forest ecosystems produce ligneous biomass (an ecological function); this biomass only becomes a supply service once humans have harvested it (social dimension). Yet this relevant distinction raises several questions when monetary valuation is envisaged. A function may result in the provision of several services: the production of ligneous biomass potentially provides wood supply, carbon storage services and even support services in terms of biodiversity (as an aged ligneous production is the source of a complete trophic chain). This gives rise to two issues. The first concerns the accumulation of values: is it possible to add up the value potentially provided by different services when the actual use of one of these services will have consequences for the provision of the

others (Salles, 2010)? This difficulty leads to another more fundamental issue: are such services compatible? Prioritising the carbon storage service automatically reduces the ligneous production service. The incompatibility between all the services poses a considerable evaluation problem, as Bradley J. Cardinale *et al. (2012)* pointed out:

> 'First, ecosystems deliver multiple services, and many involve trade-offs in that increasing the supply of one reduces the supply of another. … The value of biodiversity change to society depends on the net marginal effect of the change on all ecosystem services.'

In this case, as for many others, valuation becomes contingent: where some social groups will see a service, others will see it as a restriction or a loss. When large paper groups encourage eucalyptus plantations in South America (Gautreau, 2014), they extol the carbon storage service that these plantations provide, whereas local communities view them chiefly as a threat to their resources in terms of biodiversity, water and, not incidentally, available land. Solen Le Clec'h *et al.* (2014) have perfectly expressed this quandary in looking at how to spatialise and map ecosystem services concretely:

> 'This raises the question of what is actually being spatialised: ecosystem services, ecological functions or biophysical processes likely to become ecosystem services? … Consequently, an ecosystem service is an intermediary between natural assets and an anthropic benefit. From a spatial point of view, the benefit logically becomes the object to represent and spatialise.'

Ergo, while it is possible to establish the existence of a function (ecosystem service in the strict sense) from an ecological point of view, it is much more challenging to put a monetary value on a social service.

As a result, it is not so much the services provided by biodiversity per se that are being appraised, but rather the use that human societies make of them. This is a significant nuance because it implies that any monetary valuation is inevitably contingent on social and cultural contexts, which paves the way to new limitations.

Monetary valuation has trouble integrating many of the services (and disservices[43]) biodiversity provides. Many authors acknowledge the challenge, if not the impossibility, of quantifying what makes up cultural

43. Disservices are ecosystem functions that are deemed to have a negative impact on human well-being.

services. How do we measure the beauty of a diversified landscape? Can the emotion felt at the sight of the Laurentian forest in autumn be translated into monetary value? Reducing an ecosystem to the monetary services it provides involves an approach that ignores the emotional and symbolic dimensions that lie at the heart of the human experience:

> 'Any wetland can perform the function of sewage treatment—but in concrete environmental conflicts, a specific wetland means more to the people concerned than this function alone. They often perceive it as an "individual" entity with symbolic values that cannot and should not be replaced by anything else—even if the replacement is functionally equivalent.' (Jax *et al.*, 2013)

The endeavours of some economists to include this 'existence value' in the calculations of total economic value have come up against anthropological dimensions that cannot be calculated.

A further bias should be mentioned here. From the outset, the ecosystem services concept has focused on the positive aspects of ecosystem services, in line with the definition given by Gretchen C. Daily (1997) as 'the benefits provided to human societies by natural ecosystems'. As a result, the Millennium Ecosystem Assessment and the TEEB emphasise the benefits of nature for society. This overlooks the fact that biodiversity is not always viewed positively and can be a source of disservice (Zhang *et al.*, 2007), which can be very burdensome for societies. Until now, there has been very little research on such disservices, and these negative aspects are rarely included in monetary valuation. Bradley J. Cardinale *et al.* (2012), while insisting on the importance of biodiversity, especially microorganisms, mentioned those cases, admittedly rare, where an increase in biodiversity can lead either to a deterioration in ecological conditions or to social problems:

> 'For example, although diverse assemblages of natural enemies (predators, parasitoids and pathogens) are frequently more effective in reducing the density of herbivorous pests, diverse natural enemy communities sometimes inhibit biocontrol, often because enemies attack each other through intra-guild predation. … Another example relates to human health, where more diverse pathogen populations are likely to create higher risks of infectious disease, and strains of bacteria and viruses that evolve drug resistance pose health and economic burdens to people. Such examples caution against making sweeping statements that biodiversity always brings benefits to society.'

Henceforth, two questions come to mind. Is it possible to appraise the cost of such disservices? And should we pay for their destruction, in other

words, for biodiversity loss? These various maladaptation factors are at the root of significant biases in the action plans adopted.

While the original idea behind monetary valuation was indeed to put a price (if only indicative) on ordinary biodiversity, with remarkable (because threatened) biodiversity being excluded on the grounds of its intrinsic value (Chevassus-au-Louis *et al.*, 2009), reality (i.e. the action schemes implemented) has turned out quite different. As political scientists Fanny Guillet and Luc Semal (2018) pointed out, the list of rare and threatened species remains the benchmark for measuring the extent of biodiversity losses and for diagnosing possible losses and the actions to be taken.

This contradiction between initial principles and the reality of applications is perfectly intelligible from a legal standpoint. As emphasised by legal experts Mathilde Hautereau-Boutonnet and Ève Truilhé-Marengo (2016):

> 'Only a part of biodiversity that is described as "remarkable" has any actual status, outlining the rights and obligations of public and private operators … By contrast, ordinary biodiversity … which is decisive in many respects, particularly with regard to the fight against global warming, is considered to be part of the private property of those who own or use the land.'

As with the previous modes of action, there is a divide between remarkable and ordinary biodiversity, which is just as detrimental to the conservation of all the interactions within living organisms. Ultimately, biodiversity is never appraised as a whole but only in part.

Lastly, setting a monetary value comes up against highly diverse territorial realities involving players with different perceptions. Paul Arnould and Hervé Brédif (2004) used the example of the Grésivaudan valley to show how stakeholders (elected representatives, foresters, environmentalists) from the same place attach very different values to woodland areas and prioritise different services. Assigning a monetary value to biodiversity or some of its components inevitably simplifies and reduces the benefits stakeholders perceive, even when that value is negotiated.

Accordingly, the monetary approach to biodiversity is reductive and hardly capable of considering the diversity of the processes involved and the social issues at stake. Adopting operational measures (such as payments for environmental services and avoidance-reduction-compensation measures) has simplified the dimensions taken into account, leading de facto to a fragmented and piecemeal approach to ecosystems and biodiversity,

whereas on the contrary, the question raised was that of interactions between scales, components and dimensions, in other words, the question of totality and unity (Brédif, 2016).

A simplistic view of humans and their deep motivations

The work of economists to appraise the value of biodiversity is based either on the observation of the stakeholders' behaviour, on direct observation of the value of certain goods on the market, or on questionnaire surveys to determine the value that these stakeholders would be prepared to place on biodiversity. Without going into the details of these methods, which have already been largely discussed, they are all marked by a more or less explicit presupposition, namely that individuals are above all *homines œconomici* acting to achieve their own well-being, as stressed by economists Hélène Tordjman and Valérie Boisvert (2012):

> 'The first, the rationality hypothesis, assumes that economic agents are logically coherent and proceed by cost/benefit calculations to maximise their wealth, a simplification of the philosophical doctrine of utilitarianism. They are not caught up in social relationships but in small and autonomous decision centres; they experience no emotions and have no history, culture or geography. However, they are almost omniscient and know how to count.'

While, in theory, this utilitarian approach may also incorporate 'non-instrumental values' (we can wish for the conservation of a species although it is of no use to us), in practice, the concepts of benefits, constraints and quid pro quo are mobilised. They paint a picture of 'a society of individuals focused on pursuing their individual interests and incapable of "forming a common cause"' (Hériard-Dubreuil and Dewoghélaëre, 2014). The utilitarian approach does not always leave the collective dimension aside. Nonetheless, it is still defined by the sum of individual utilities. As emphasised by another economist, Leslie Carnoye (2018), the Millennium Ecosystem Assessment clearly associates the concept of well-being with 'individual freedom of choice and action'.

Under such conditions, community schemes for dealing with biodiversity are downplayed or simply ignored. This is still very much in line with Garrett Hardin's (1968) perspective and analysis of the tragedy of the commons, where, ultimately, stakeholders only pursue their own short-term interests. The work of Nobel Prize-winning economist Elinor Ostrom (2000) on natural resources management has clearly demonstrated that contrary to Garrett Hardin's conclusions, local societies

can have adequate means of resource management and that, provided a certain number of rules are respected, particularly concerning dialogue between stakeholders, decentralised management can achieve excellent results, superior to those obtained from a centralised, hierarchical approach. The underlying individualism of the monetary concept and the schemes that derive from it confine human beings to an individual dimension, far from corresponding to all their aspirations and the social interactions that define them (Maris, 2009). One consequence of this is the incomplete, even biased appraisal of the value of biodiversity. Not only is the sum of individual values random, but it is also ill-suited to accounting for other equally fundamental parameters, such as distribution, equity and inequality issues within social groups (Carnoye, 2018). Moreover, valuation potentially reinforces such inequalities, as Virginie Maris (2009) pointed out:

> 'The wealthier can allocate more resources to what they value, and the real or simulated market only reflects the interests of those who can afford to participate.'

This touches on another oft-mentioned bias, namely the difficulty, if not the impossibility, of truly regulating markets to ensure undistorted competition between players on an equal footing, which is still a utopian dream (Chevassus-au-Louis, 2011).

One of the main criticisms of the monetary approach is that it is primarily instrumental, reflecting the utilitarian bias outlined above. Yet this instrumental value is far from covering the range of values we ascribe to nature (Jax *et al.*, 2013). Precisely, any instrumental value implies the exteriority of the object with respect to the acting subject, a divide between the 'agent' and the 'goods' following the terminology used by Olivier Godard (2005). This exteriority is now considered as one of the leading causes of biodiversity loss, as argued by Cécile Barnaud and Martine Antona (2014). Following on from the human ecology work of Carina Borgström Hansson and Mathis Wackernagel (1999), Cécile Barnaud and Martine Antona even concluded that the monetary approach reinforced the decoupling between humans and biodiversity:

> 'According to these authors, work on economic evaluation of ES [ecosystem services] is not the solution to the problem as it is just a step further in the disembedding process.'

The need for reconciliation between humans and non-humans (Rozenweig and Michael, 2003), regarded as one of the clues to effective

action against the erosion of biodiversity, would be marginalised, or even stifled, by this externality. Decoupling would hamper the consideration of a set of non-monetary values that are nonetheless fundamental:

> 'From her prison, Rosa Luxemburg wrote in 1916 (Luxemburg, 2009), "every day I visit a little red ladybug …, which in spite of the wind and the cold, I have been keeping alive for a week on a bough warmly surrounded by cotton wool. … [O]n the whole, I feel that I am no more important than the ladybug and I am inexpressibly happy with this sense of my insignificance." Who could say, under such circumstances, how much the ladybug is worth?' (Simon, 2018)

Yet non-instrumental values, which are difficult, if not impossible, to include in a hypothetical total economic value, are doubtless essential to mobilising stakeholders, raising their awareness of the 'benefits' of nature and encouraging them to take action. This potential for commitment is part of the 'transformational value' described by Virginie Maris (2009):

> 'In today's over-consuming and wasteful societies, contact with nature, the study of its diversity and the contemplation of its complexity are a powerful source of inspiration that offer invaluable resources for assessing, refocusing and adjusting our aspirations. Once again, such a benefit cannot be reduced to economic valuation.'

As an extrinsic motivator for stakeholders, monetisation does not help activate levers for action, although they are important. Monetisation excludes part of the world population for whom this exteriority does not exist (Descola, 2005) or even for whom money itself and commercial trade are inconceivable. As we previously mentioned (Brédif *et al.*, 2017), other intrinsic motivations constitute stimuli that are at least as effective, if not more so, for many researchers and practitioners than reward or constraint. Amidst the plethora of research and theories on motivation, psychologists such as Marylène Gagné and Edward Deci (2005) argued that practitioners pursue specific objectives with more determination and consistency when these objectives are based on intrinsic goals (which come from the practitioners themselves, from the interest and pleasure they derive from their actions, and not subordinated to an external stimulus) rather than extrinsic motivation (i.e. punishment, reward or incentive, social pressure).

This very liberal—in the economic sense of the term— view of the individual is refuted by many economists who, like Elinor Ostrom and Amartya Sen, believe that the individual is not a mere consumer but also a citizen whose concerns go far beyond satisfying their interests. While

they should not be dismissed outright, extrinsic motivations alone do not appear to provide a solution to the problem. Research led by Tom Dedeurwaerdere *et al.* (2016) on several examples in Europe, concluded that intrinsic motivation is an essential factor in the success of the initiatives undertaken.

However, the risks inherent in this approach and this conception of the human being run even deeper. Quoting research carried out by Uri Gneezy and Aldo Rustichini, Alain Karsenty and Driss Ezzine-de-Blas (2014) warned about the perverse effects of instrumental approaches:

> 'Recent literature in the economics of law suggests that a shift in the hierarchy of motivations is possible when an inappropriate monetary incentive is offered to initially disinterested social actors. Uri Gneezy and Aldo Rustichini describe an experiment carried out in crèches in Israel. To limit the number of parents late to collect their children after closing time in the evening, a financial penalty of 10 shekels (around 2.7 US dollars) was implemented for parents who were over ten minutes late. Parents reinterpreted this initially dissuasive sanction as a right to tardiness. Compared to the cost of babysitting, the fine was much lower. As a result, rather than decreasing as the deterrence theory would have it, the number of late parents almost doubled. The authors analyse the situation produced: whereas previously, parents generally did their best not to inconvenience the staff who continued to look after their children after closing time, free of charge, the introduction of a fine was interpreted as a price for a service, which allowed them to come late (hence the title of the article: "A fine is a price"). The monetary incentive supplanted the altruistic motivations that encouraged parents to try to be on time.'

Transposed to our field of concern, such a drift could culminate in the idea of a right to destruction, as Georges Ribière (2013) posited:

> 'In other words, the financial schemes generated by the markets could eventually lead to a pernicious attitude: protect here to have the right to destroy elsewhere.'

Baptiste Regnery (2017) has highlighted the risk associated with the implementation of the avoid-reduce-compensate doctrine: risks of greenwashing (the emphasis is on gains without mentioning all the losses), of supporting the loss (the baseline state is placed on a trajectory of decline, with compensation serving to limit this decline, not to halt it), and rebound effects (the compensation effort results in an increase in removals). Taken to the extreme, payment systems could lead to an increase in existing threats, as highlighted by Alain Karsenty and Driss Ezzine-de-Blas (2014):

> 'In other words, it is in their [a forest or wetland owner's] best interests to propose a worst-case scenario of the destruction of nature to obtain maximum financial compensation for not carrying through with their project.'

Disconnection from nature, emphasis on extrinsic motivations that are not necessarily inspiring, impoverishment of the wealth of connections between humans and nature: such are the limitations identified by many authors and which are inherent in this utilitarian approach. Concretely, this monetary rationale can even adversely affect the biodiversity it means to protect!

Lastly, and this is another occasionally mentioned limitation, this rationale also generates a form of hubris. Without launching into a philosophical debate, however essential it may be, the risk of an instrumental approach is losing sight of the objective pursued in trying to conserve the diversity of life forms. The point is not to conserve resources (a static notion) but to conserve a potential for evolution that depends on human actions but is not limited to them. The evolution of living things began long before humankind and will no doubt continue long after it has gone. The wealth of this ongoing creation needs to be preserved, and this certainly goes well beyond the question of its utility. Therefore, the question of the utility of biodiversity is important, but it is probably not central to the dynamics of living things. As per Pierre-Henri Gouyon (2007):

> 'We can argue about the utility of biodiversity for humans—and I think we should— but that is not the number one issue. Most important is how we perceive ourselves in our relationship to nature, from which we come, of which we are a part …'

Hence, biodiversity preservation cannot be seen in its utility alone: it is an ethical issue.'

A mode of action that is establishing itself as the solution

The limitations and perverse effects we just mentioned are not enough to question the quest for valuation, which is repeatedly stressed in international texts and tends to take precedence over other possible actions. It stands out for its relative simplicity, which is, after all, one of the sources of its lack of efficacy. Accepting payment or compensation in exchange for a biodiversity loss (or absence thereof) endorses a process which is relatively straightforward to implement once the price has been set. Alternative forms of action, which would involve consultation or education, require

time that is not always compatible with the decision-making timeframe, according to some economists:

> 'Dialogue … takes time, time that is not available for development projects; participation is difficult to envisage on a large scale; stewardship projects[44] can seem derisory compared to the imperatives of growth and job creation.' (Rivaud and Prévost, 2018)

This concern for efficiency and simplicity is consistent with the development of the payment for environmental services and compensation approach. In their study on compensation, Coralie Calvet *et al.* (2015) noted the shift from a predominantly ecological approach in the period 1996–2006, with a focus on environmental functions and discussions on ecological equivalence and restoration, to a more economic approach in the period 2007–2014, with frequent use of economic terms (cost, incentive, payment, exchange). This reduces the debate to monetisation alone, which considerably limits the scope of the discussion (Lalucq, 2017). Cécile Barnaud and Martine Antona (2014) have even gone so far as to refer to ecosystem services as a new tyranny:

> 'This concept has indeed become the key word of numerous calls for tender and therefore shapes more and more research and policy initiatives dealing with conservation and environment.'

The success of the ecosystem service concept has resulted in its acceptance by many decision-makers. These stakeholders view it as an efficient and compelling tool, but it has been stripped of its complexity:

> 'To quote Latour (1987), politicians tend to act as if ecosystem services were a form of "ready-made science", with well-understood causal relationships and certain, stable and "cold" knowledge that is no longer challenged, whereas ecosystem services are in fact a "science in the making", with uncertain and unstable knowledge.' (Barnaud and Antona, 2014)

Ultimately, a highly managerial and technical approach to biodiversity now prevails, sometimes supported by some scientific currents in restoration ecology and certain NGOs (Calvet *et al.*, 2015). For many authors, this evolution reflects subordination to the liberal ideology and the new public management rationale (Guimont *et al.*, 2018).

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44. 'The aim of land stewardship (IT for *intendance du territoire*) is to transform nature management methods from the bottom up.' (Rivaud and Prévost, 2018)

From an approach designed to foster debate and provide knowledge and assessment, the ecosystem services approach has gradually been transformed into a tool serving supposedly efficient public policies. The conclusions of economists Charlène Kermagoret *et al.* (2015) support this point of view:

> 'Yet, compensation does not go as far as challenging the very nature of development projects concerning territorial interests. On the contrary, it provides an additional tool to meet the State's technical and economic development goals … without challenging the validity of the project.'

Several authors have noted, and more often than not regretted, this development, which has led to considering the monetary approach as the simplest and most effective solution for curbing biodiversity loss. Such an evolution unfolds at the expense of other levers and motivators and is fraught with significant perverse effects. These effects occur at several levels. On the one hand, as we have already stressed, monetisation distracts attention from a genuine assessment of the effectiveness of the actions carried out. Lack of control and precision (often due to a lack of dedicated funding) translates into the lack of additionality of the measures adopted. Alain Karsenty and Driss Ezzine-de-Blas (2014) used the example of the measures adopted in Costa Rica to limit deforestation:

> 'In Costa Rica, the State remunerates forest owners under a PES [payment for environmental services] scheme, but several studies have shown that these payments have not influenced the landowners' land-use decisions: the same choices would have been made even without remuneration; more than 90% of the payments are deemed windfall effects.'

The same observations have been made regarding specific agro-environmental measures in Europe (Duval *et al.*, 2015). Alongside this lack of additionality, there is also the 'blackmail rationale' mentioned by the socio-economist Alain Karsenty *et al.* (2010) regarding the French schemes to reduce emissions from deforestation and forest degradation, REDD. By providing a simple and ready-to-use solution, monetisation prevents any prior debate on the merits of specific projects. Such a rationale is reflected in the avoid-reduce-compensate policy through the low priority given to the avoidance phase in many projects (Bigard *et al.*, 2018).

While these perverse effects contribute to the relatively low effectiveness of this action method, other even more negative aspects have been pointed out. Fanny Guillet and Luc Semal (2018) have outlined how the

compensation policy has led to the relative disengagement of the State in favour of market mechanisms and to the abandonment by competent services of traditional tasks linked to the conservation and maintenance of natural heritage:

> 'Biodiversity offsetting constitutes a growing part of administrators' activities. This may effectively displace their capacity to focus on their responsibilities for other nature conservation tools such as protected area designation, the green and blue corridors policy, national action plans for species, and so on.'

A similar trend has been observed in France in nature conservatories, where the proportion of public funding has been reduced in favour of financial income linked to the management of compensatory measures. The same trend is affecting environmental protection organisations, which, as a result of subsidy cuts, are seeking to make up for these shortfalls by resorting to compensation funds:

> 'For example, they manage compensatory sites, support farmers to apply management measures, or perform ecological monitoring. Their involvement shifts their ways of working to the detriment of traditional actions for nature conservation such as advocacy, legal action, or natural site protection.' (Guillet and Semal, 2018)

This development has profoundly affected all the natural environment protection and management schemes. This also means that the understanding of the multiple dimensions of the biodiversity crisis is reduced to its single quantitative and utilitarian dimension, at the risk of leading to aberrations such as: the rarer a good is, the more it is worth; the more it is worth, the higher the demand; the higher the demand, the more it is destroyed. This is how rhinoceroses disappear.

If living things are reduced to their utility, then, as Aurore Lalucq (2017) has expressed with concern, will we have to let bees disappear the day 'smart' drones can provide an efficient (and 'profitable') pollination service?

Yet this rationale, fraught as it is with consequences, is at work today through specific mechanisms that pave the way for the commodification of living things.

Harold Levrel and Antoine Missemer (2019) pointed to the shift towards the vocabulary of economic valuation, which could be interpreted as indicative of a market rationale and progressive financialisation (Figure 12):

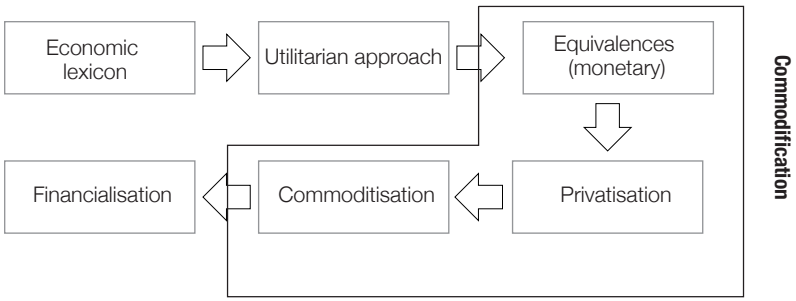

Figure 12. The causal chain of the economisation of nature (source: Levrel and Missemer, 2019)

> 'The process of economising nature would begin with the use of an economic lexicon to talk about the components of nature; this lexicon would result in an instrumental (and utilitarian) vision of nature; an equivalence (often monetary) of its components would then occur; this equivalence would facilitate privatisation, which would lead to the commodification of nature; and the most advanced stage of this commodification would be that of financialisation.'

As Georges Ribière (2013) has pointed out, a market rationale is gradually emerging at the international level. While we should avoid fantasising, as Raphaël Billé (2011) has suggested, the fact remains that the commodification rationale is at work and that powerful relays are available to it. The TEEB report (2011) had already clearly stated this when formulating the following argument (which is not supported by any genuine evidence):

> 'Experience shows that environmental goals may be reached more efficiently by market-based instruments than by regulation alone.'

Such a statement serves a twofold purpose that should not be overlooked. Not only is this a call to the market, but at the same time, it undermines the credibility of more traditional modes of action, which are based on political decisions and administrative implementation. Alain Karsenty and Driss Ezzine-de-Blas (2014) have summarised this as follows:

> 'In short, it is either bureaucracy or the market. To describe a set of regulatory techniques that have such a metaphorical relationship with real markets as "market-based instruments" is to promote a fictional world organisation in which the market is identified for environmental management as the only intelligent alternative to bureaucratic directives.'

For many authors, claiming that the market is the only efficient tool is a contradiction akin to the firefighter-arsonist rationale (Maris, 2009). In this sense, Hélène Tordjman and Valérie Boisvert (2012) have stated that:

> 'It seems complicated, even paradoxical, to believe that the market economy and industrial capitalism can work to save the planet when they are manifestly the source of many of the threats to the biosphere's regulatory mechanisms. Yet, this is the prevailing belief.'

There are many examples of this powerful trend, and its impact cannot be underestimated. As early as the 1980s, the US Supreme Court endorsed the idea that living things could be patented, paving the way for their appropriation and commodification. In the compensation field, several hundreds of banks are now dealing in compensation, overseeing a rapidly growing market. Christophe Bonneuil and Geneviève Azam (2011) have stressed the expanding role of investment funds in ecosystem services at the international level.

These private players are widely represented in the organisations that propose biodiversity strategies. The official document resulting from the Rio+20 negotiations was thus drafted upstream by a partnership bringing together the UN, the International Chamber of Commerce and Industry and the World Business Council for Sustainable Development (WBCSD)—which includes the largest multinational corporations, such as General Motors, DuPont, Coca-Cola and Shell. According to Hélène Tordjman et Valérie Boisvert (2012):

> 'Several "green assets" already exist, albeit marginally, but they are certain to develop, given their relevance to the spirit of the times and the impact they are likely to have. As with compensation or benchmarking, these proposals emanate from powerful nebulous groups involving United Nations agencies (UNEP, World Bank), bank federations and large corporations (e.g. the World Business Council for Sustainable Development), conservation NGOs such as the IUCN, WWF, The Nature Conservancy, etc. Hari and Sullivan (2010) have described and denounced these often unhealthy relationships and obvious conflicts of interest.'

This commodification rationale is definitely underway nowadays. It is not confined to the private sector but includes public administrations and international bodies. One should bear in mind that a company that builds a major infrastructure (high-speed line, motorway, etc.) does so at the request of the public authorities. This is why it is not just a matter of economics but of politics and also why it raises questions in this area.

A socially and politically questionable implementation

Implementing market systems is based on decision-making processes that are not always transparent. An ecosystem service should not be equated with an indisputable objective reality. Research by Lars Hein *et al*. (2006) has shown that the stakeholders in a wetland zone in the Netherlands could have very different expectations in terms of services. While local stakeholders prefer supply services and income-generating leisure activities (fishing, reeds), national stakeholders focus on regulation services (water quality, carbon storage) and NGOs on support services; biodiversity protection, in this instance. Decisions to take action will not necessarily be the same depending on the service prioritised. In addition, there is often a gap between service providers and beneficiaries, as mentioned by Irene Ring *et al*. (2010):

> 'The task is to reconcile the local costs and global benefits of biodiversity conservation, because the costs of conserving ecosystems and biodiversity fall mostly on local land users and communities, whereas the beneficiaries of conservation are found not only at local levels but also far beyond, at national and global scales as well.'

Where different views can be expressed on the type of services that should be prioritised or on the respective roles of the providers and beneficiaries of these services, the debate shifts to the political arena of decision-making. The central question is indeed that raised by Kurt Jax *et al.* (2013): 'Who makes the choices and for what purposes?'

Political science and social science, in general, have pointed out the knowledge and power asymmetries in decision-making for a long time. Brett S. Matulis (2014) has shown how these commodification mechanisms could contribute to reinforcing territorial inequalities. Often, social injustices overlap with spatial injustices. Alain Karsenty and Driss Ezzine-de-Blas (2014) have illustrated this inequitable process through the following example:

> 'Blocking a right of use such as land clearance, hunting, or charcoal production reduces opportunities to overcome poverty. Often, the poorest members of a community are those who depend on natural resources. In giving up certain activities, they lose vital access rights, which payments calculated on an average opportunity cost for the community do not usually compensate. In addition, it is not uncommon for these payments to be monopolised by the elites.'

Far from reflecting the objective value of biodiversity, payment schemes are likely to increase inequalities. Again, monetisation comes up against

the gap between theory based on an unbiased market and reality. When Kurt Jax *et al.* (2013) mentioned the conditions that must be met if these instruments are to be used fairly ('explicate the definition, context and purpose; clarify and respect the various values and assessments; clarify and reflect on possible conflicts and compromises'), they were, in fact, proposing a method which, because of its complexity, duration (mainly due to the discussions and compromises required) and the uncertainty of results, is difficult to reconcile with the efficiency claimed and desired by the market approach to biodiversity.

Criticism review

As in the case of the two previous strategic directions, specialists in the field are challenging the situation to varying degrees. Two powerful criticisms emerge from this overview. One is of a philosophical and moral nature and concerns a position of principle: ascribing a monetary value to living things amounts to degrading them, robbing them of their sacred dimension, and ultimately viewing them as relative. In the final analysis, the issue is mainly ethical for the authors who support this position. The relevance of this criticism is such that it is found even among proponents of monetary valuation, who are quick to point out the intrinsic value of biodiversity. If they agree to adhere to the monetary valuation rationale, it is only out of concern for realism and efficiency.

The other criticism centres more on the relevance of the approach and the appropriateness of this type of action given the complexity and unpredictability of life. Ecologists, in particular, stress the difficulty, if not the impossibility, of accurately coupling a service provided with an ecosystem. They draw attention to the fact that the dynamics and unpredictability of living organisms make such a link even more uncertain. They are backed by social scientists, who stress the difficulty of isolating the part of the service provided by nature from the one resulting from human action, and by legal experts, who refer to the indivisibility and non-transferability of biodiversity. Similarly, there appears to be reasonably broad agreement, both in the human and social sciences and in the life sciences, that the contingency of services also involves considerations that are difficult or impossible to 'evaluate', in this case, the symbolic, affective and emotional dimensions that link human groups and individuals to biodiversity. The complexity of the relationships between living beings (between non-humans and between humans and non-humans) ultimately removes

much relevance to the economic valuation of biodiversity. Lastly, economists and legal experts agree that in practice, when it comes to assigning a value, and contrary to the claims about its 'intrinsic value', remarkable biodiversity takes pride of place, whose importance can best be assessed.
Other criticisms, however, seem more moderate. They do not necessarily challenge the valuation principle itself; instead, they question its capacity to foster the appropriate levers for action, adapt to the diversity of situations, and involve all the players by leveraging their effective motivations. These criticisms agree that the services provided are contingent and sometimes contradictory and that little attention is paid to disservices, although these are important and socially unpopular. Their authors often insist on the conditions that would facilitate the use of valuation without undermining social and territorial cohesion or the depth and diversity of the links between humans and non-humans. Many of these conditions seem draconian and still far removed from current practice, even though case studies and success stories in some areas suggest that progress is possible.

Regulating and integrating at the risk of globalisation

Unlike the previous strategic directions, biodiversity governance on a global scale is far less studied and commented on. There are several reasons for this.
The vast majority of ecologists, conservation biologists and naturalists take little interest in the workings of UN institutions: the political aspect of the biodiversity loss issue is not their area of study or spontaneous interest. In the nature protection and biodiversity conservation field, the divide between science and politics is so pervasive that many people act as if, once a scientific diagnosis has been made, the rest is just a matter of 'political will'. Thus, as political scientists Daniel Compagnon and Estienne Rodary (2017) have confirmed, 'biodiversity is a relatively neglected topic in the social sciences, and even more so in political science, particularly in France'.
Furthermore, few researchers have the time and funds to attend international conferences held in the hushed confines of diplomatic exchanges that seek to remain discreet. As a result, comments on the limitations of the UN process in its search for global governance of biodiversity

originate from only a few specialists—political scientists, lawyers, sociologists, geographers, and experts in governance and environmental management. Finally, this is a relatively new field of research which has not yet reached full maturity:

> 'Only a small fraction of international relations specialists identify the environment as their main field of investigation, and only a modest proportion of articles in generalist international relations journals focus on environmental governance.' (Morin *et al.*, 2020)

The thwarted dream of integrated global governance

According to some thinkers on the environmental crisis and specific activist movements, hope lies in the greater globalisation of public policies and governance processes for ecological issues. Hence, philosopher Michel Serres has called for the creation of a WAFEL[45], while others bank on the advent of a world environmental organisation or an ecological democracy (Bourg and Whiteside, 2010) with new representation modes that would give environmental NGOs a leading role. In light of the threats and uncertainties facing the environment and biodiversity, the 'solution' would lie in greater global integration and the establishment of a set of rules, standards, control and monitoring mechanisms to ensure the 'proper protection of Earth's ecosystem'. Practically speaking, however, these concepts come up against serious obstacles.

A first and commonly raised objection stems from the dominant economic and societal model into which the subject of biodiversity is placed. Facing economic growth and employment issues, despite the alarmist warnings of many researchers, biodiversity is still struggling to be acknowledged for its importance. Under such conditions, whether greater integration in biodiversity governance alone will guarantee more effective international policies and strategies remains doubtful. This classic argument takes on particular significance when it is developed by political scientists anxious to bolster the effectiveness of international biodiversity policies. In

45. WAFEL, for water, air, fire, earth and life, is a world parliament of things. Its members are the 'direct representatives' of what Michel Serres calls Biogée, i.e. specialists in the life and earth sciences, the only ones in a position to give voice to the objective world (see *Temps des crises*, 2009).

the introduction to the collective work they published in 2017, Daniel Compagnon and Estienne Rodary expressed this quite plainly:

> 'In both Northern and Southern countries, biodiversity protection is systematically sacrificed to the imperatives of maximum economic growth and technological development. … As for climate change, but even more blatantly, the scientists' emergency rhetoric seems all the more pathetic given that public policies in the field are proving ineffective, both in the North and the South: for example, the first European and then international objective of mitigating biodiversity loss by 2010 is far from having been achieved, and the rate of loss tends to accelerate rather than slow down.'

To an even greater extent, some authors lament the fact that current environmental governance has been positively overwhelmed by the scope and vigour of economic globalisation. The insolent prosperity of transnational networks trafficking in protected species, despite international protocols and regulations, is a worrying illustration of this.

The second challenge is outlined in social science research in particular. It stems from what is known as the fragmentation of the international biodiversity regime. Unlike the previous point, this is not an external obstacle; rather, it stems from the fact that the actual structure of the international biodiversity regime is still insufficiently integrated: concepts, standards, protocols and measurement, monitoring and control mechanisms are not always adequately connected, consistent and synergistic. Consequently, the scope and effectiveness of the strategies and policies rolled out are dramatically undermined.

Among other possible illustrations, a perfect example is that of the high seas, an area that escapes national jurisdictions. Legal experts Ana Flávia Barros-Platiau and Sandrine Maljean-Dubois (2017) provided an overview of the current situation, which raises questions:

> 'The international bodies were created as global issues and crises arose, without an overall plan. This is reflected in the governance of the biological resources of the high seas, which are legally at the crossroads of a large number of conventions relating to the law of the sea and fisheries, environmental law and international economic law. … Hence, this governance remains both fragmented and incomplete (Freestone *et al.*, 2014). Commonly referred to as the "Constitution of the oceans" or "Global framework for the governance of human activities in the oceans" (Ban *et al.*, 2014), the Convention on the Law of the Sea sought to unify ocean law and address the fragmentation issue; not only did it fail, but it may even have amplified it (Tladi, 2011). Similarly, at the regional level, policies relating to marine resources remain highly fragmented.'

Not everything is negative in the current state of governance. Paradoxically, the current fragmentation can also create flexibility and breathing space that an excessively rigid framework would have prevented (Biermann *et al.*, 2009). Moreover, the legal experts quoted above count on the growing awareness of the harmful consequences of shortcomings in global environmental governance, and they bank on the emergence of a defragmentation process, even though it will undoubtedly take time for a better integrated global framework to emerge.

Other researchers seem less optimistic, either because they feel that the current period is hardly favourable to multilateralism or because they doubt that it is possible to go much further regarding global environmental governance integration.

Lastly, as sociologist Antoine Vauchez has pointed out in the newspaper *Le Monde* (11 September 2020), the challenge of putting together a genuinely cross-functional environmental policy also comes up against the fragmentation of administrations and policies at the national level:

> 'Environmental policy has three defining characteristics: in practice, it is highly sectoral, even though it rightly claims the need to be cross-sectoral; it essentially gravitates around independent agencies, which play the ambiguous role of both protecting the public and organising the markets; and the political initiative very often comes from the European level. … Environmental policy must find its place among a nest of traditional policies—transport, energy, agriculture, industry, telecommunications, etc.–which are rolled out by sectoral bureaucracies, each with its specific history, stakeholders (farming unions, industrialists, major national operators, etc.).'

The last objection, although less common, is nonetheless essential. It does not so much stem from the social sciences as from researchers, admittedly quite rare, who reason in terms of the concept of biodiversity itself. Behind the apparent unity of the concept, the reality is much more complex and even difficult to grasp. Isn't the nature of biodiversity, its constituent characteristics and the many interactions that influence it incompatible with the possibility of unified governance? Is it reasonable, then, to pin one's hopes on a global biodiversity policy or strategy when, in truth, the issue itself is so complex, heterogeneous and diverse, hinging on factors and contexts that are as heterogeneous as they are disparate?

In 2005 already, economist Olivier Godard drew an instructive comparison with climate change:

> 'Furthermore, it is doubtful that the idea of planetary biodiversity has the same consistency, i.e. demonstrates the same level of integration and

> interdependence, as that of planetary climate: from a functional point of view, biodiversity expresses itself preferably at distinctly sub-planetary levels, as it is highly dependent on the particular physical and geographical characteristics distributed over the planet. … Unlike the climate, developing a management approach for biodiversity is hampered by the absence of a general equivalent that would help compare the impact of the countless human actions that affect it. On the one hand, the targets are diverse and cannot be added up convincingly. … On the other hand, human actions affect biodiversity through multiple, often indirect, influences.'

In his way, Alain Pavé (2019) also pointed to the inherent complexity of biodiversity, which is not easy to grasp and, consequently, resists a comprehensive, stable and programmatic policy approach:

> 'First, the biological and evolutionary dimensions are complex and largely unknown. Evidence of the multiple interactions of living beings with one another and with the anthropological, sociological, technological and economic components add a layer of complexity. This does not mean that we cannot, or worse, should not do anything; instead, we should include an evolutive vision to our plans, in the sense of our practices, constantly integrating quantitative and qualitative data and advances in our knowledge to, once again, promote an adaptive approach to the issue and the "management" of living things.'

The perverse effects of a top-down globalisation

In addition to the biodiversity governance globalisation project's limitations, various authors regularly point to its perverse effects. The clearest of these paradoxical effects concerns the domination of the UN process by institutions and experts from the countries of the Global North, and even more so by a very Western conception of the character of the relationship of human beings to nature. Not only does the dominant language, international English, shape the debates, but the approaches are still heavily influenced by utilitarianism, anthropocentrism and dualism, with the social sciences only playing a marginal role. For instance, here is what a group of conservation biology researchers wrote:

> 'Conservation organisations or funders may have an organisational culture that primarily employs, understands, or values the natural sciences…There is often a resistance to changing this focus to include and fund more social science perspective. Some individuals or organisations may even feel threatened by the insights social scientists provide, particularly when those insights challenge entrenched practices and narratives.' (Bennett *et al.*, 2016)

More broadly speaking, these processes are still largely influenced by Western concepts and values, if only because of their cost of access, as political scientists Jean-Frédéric Morin, Amandine Orsini and Sikina Jinnah (2020) have pointed out:

> 'The gap in material resources is particularly significant between non-governmental players in developed countries and those in developing countries. For instance, most NGOs and companies involved in international negotiations come from developed countries. The cost of attending countless meetings around the world is prohibitive enough to discourage organisations with few material resources, i.e. the majority of non-governmental actors in developing countries.'

Another adverse effect of UN processes is the dominance exercised by the Member States, the only parties genuinely recognised by the Framework Convention. Admittedly, over time, the UN process has granted status to several non-governmental players as part of what the UN calls 'major groups'. Aside from the fact that the definition of these groups is similar to that of 'interest groups', it is worth noting that in most cases, their role is limited to observing or influencing and that they are not parties to the decision-making process as such, which is the prerogative of the Member States. The result is technical-administrative approaches in which standards prevail because they are the governments' preferred means of expression. The social sciences are baffled by this top-down management approach as it is doubtful that governments have the internal resources to deal with the complex situations created by biodiversity loss:

> 'With environmental change, the relationship is reversed: administration must learn from a multiform people, on multiple scales, what it might be like to live in territories entirely redefined by the need to break away from today's globalised production. It would be utterly incapable of dictating measures from above.' (Latour, 2020)

> 'Even if they wished to, States and global corporations would not know how to respond because they lack the concepts to change. This would require a new critique of science in the industrial world. Science is entirely subservient to the development of industrial capitalism and, thus, it is no longer autonomous, unlike in the eighteenth century. … If science doesn't heal, it is because it has been compartmentalised. Taylorisation is now being applied to the sciences, which is extremely serious: it is a science of parts in which there is no whole. We live in disruptive times, where all the cards are being reshuffled. Consequently, we must review a lot of our thinking and rebuild knowledge. This involves revisiting all our legacies and inventing a new vocabulary of knowledge.' (Stiegler, 2020)

Although local and territorial initiatives for biodiversity are increasing and spreading, international processes still accord them negligible attention[46]. To explain this discrepancy or anomaly, Hervé Brédif (2016) suggests that this set of initiatives has not yet reached the critical mass that would enable it to assert itself as shared evidence whereafter it might be genuinely considered. Many institutions, officials and experts act as if this was of little significance given the scale and seriousness of the 'global problems'. People's minds and attention are elsewhere. Observation, study and research capabilities focus on the material dimensions of the ecological crisis rather than on potential changes in the attitudes and practices of stakeholders, especially those who are individuals or small communities. Besides, reports drafted by international bodies (i.e. UNEP and IPPC) tend to focus on large-scale actions and measures, which are easier to compile, compare and assess. This, in turn, reinforces the apparently global nature of the phenomena under consideration, giving even greater legitimacy to research conducted on such a scale.

Finally, we should mention that, sometimes, the assessment is much stricter. Some believe that the globalisation of environmental issues fuels a superstructure comprising UN agencies, international bodies and technocrats, which tends to operate in a vacuum and has lost sight of grassroots realities and concerns. In some respects, international conferences and even instruments such as the sustainable development goals also —and sometimes primarily—serve to ensure the reproduction of a type of global bureaucracy, the utility and effectiveness of which remains to be clearly demonstrated. Consequently, governance globalisation might tend to become an end in itself rather than serving a genuine project for society.

Persistent dichotomies which elude the field of the commons

The most significant consequence of this propensity towards the globalisation of governance is also the least noticeable: it is as evident as a blinding sun one can hardly look at directly. Several authors mention it

46. By way of example, a few words are enough to dismiss the issue in the Leaders' Pledge for Nature (2020): 'Notwithstanding many local success stories, the global trends continue rapidly in the wrong direction.'

incidentally. Thus, in their book Les *Enjeux de la biodiversité* (1998), economists Catherine Aubertin and Franck-Dominique Vivien noted that the public/private distinction completely shapes how global strategies on biodiversity are conceived. Indeed, the Convention on Biological Diversity establishes the sovereignty of States over biodiversity as a fundamental principle. However, the discussions and protocols concerning access to and sharing of genetic resources are based on the public regulation of private rights. Often unawares, ecologists embrace this collective/individual separation model as if it were perfectly natural, the only one possible. Asked to comment on what could be done to counter biodiversity loss, the apparently pragmatic response of ecologist Franck Courchamp (2019) echoed the dichotomy mentioned previously:

> 'Each of us has two trump cards up their sleeve. First, the elector's card: if they want to be elected, politicians do what electors want. Vote for those who put the environment first. Then, there's the credit card: your consumption choices make a huge difference (less meat, less packaging, less palm oil, etc.)'

Yet, this public/private dichotomy that shapes biodiversity concepts, policies and strategies is out of step with, and even in flagrant opposition to, the assertion that biodiversity is a common good or a common heritage of humanity.

In a text published in 2008 and entitled 'La biodiversité, entre appropriation privée, revendications de souveraineté et coopération internationale' (Biodiversity, between private appropriation, sovereignty claims and international cooperation), political scientist Daniel Compagnon observed that:

> 'The common good or global public good approach is challenging to apply to biodiversity, as it is claimed by States as a matter of sovereignty over their territory and appropriated by industry following a globalised market rationale.'

The discrepancy between the notion of common property or heritage and the public/private, individual/collective separation is not just a matter of form. It clashes head-on with the very logic of living things. In this line, Henry Ollagnon insists on what he calls the 'transappropriative nature' of the quality of living things, and biodiversity in particular. According to him, the quality of biodiversity depends essentially 'inside, but also through and beyond boxes of appropriation and responsibility, both public and private'. Because it circulates between the public and private fields of appropriation and incorporates their characteristics and influences, it

requires a complementary form of management as a common heritage, which does not replace the existing individual and collective modes but complements, stabilises and enriches them.

> 'In a country such as France, over the centuries, some territories have implemented highly sophisticated shared heritage management systems, while others have not. … However, in France, as in Europe, a long-term trend has emerged, correlating with the rise in power of the universalist knowledge and action approach and the development of appropriative heritages based on individual and collective public and private holders through public and private responsibility boxes. Nowadays, biodiversity degradation shows that complex, circulating and evolving realities such as biodiversity cannot be sustainably managed with an exclusively appropriative public or private heritage. These realities demand that we explore the ways and means of a "transappropriative" heritage suited to our times.' (Ollagnon, 2003)

Following Elinor Ostrom's approach to the commons, presented as a 'third way' between the State and the market, a group of researchers and practitioners from several social science disciplines (philosophy, law, management sciences) stated in the introduction to their book *Dynamiques du Commun : entre État, Marché et Société* (Dynamics of the Commons: between State, Market and Society) (Bourcier *et al.*, 2021) that:

> 'The authors proceed from the observation, shared by many other researchers and stakeholders, that the dyadic system no longer functions satisfactorily and that society, by organising itself in common, is affecting the organisation of the State and the Market. Now, if the stakeholders in society organise themselves according to the principle of the commons, two outcomes are possible: either they are constituted and develop in a dynamic, self-organised way against the dyadic system of the State and the Market, or they are constituted and develop in a dynamic, co-organised way with the dyadic system of the State and the Market. In this case, subject to a certain type of arrangement and degree of institutionalisation of relations, they constitute a triadic system; in other words, they form a system.'

The current biodiversity global governance and UN agencies' international assessment and expertise ignore or gloss over these challenges and debates. They remain trapped in the dyadic State-Market rationale. They cannot deal with the dimension of biodiversity as a common good or heritage, neither in terms of its intrinsic reality nor the organisational and institutional aspects it entails.

The need to rediscover the human dimension and human collectives

The idea that the State-market and public-private rationales form the restrictive framework within which both the issue of biodiversity loss and the responses to this problem are devised does not originate solely in the history of an international process initiated under the aegis of the United Nations and marked by the predominant influence of the Member States. This prevailing thought has deeper origins, according to Danièle Bourcier *et al*. (2013): it is based on an anthropological conception in which 'human beings are not likely to coordinate according to a shared vision of their common good':

> 'The republican conception of the State will engage individuals in its policies either using coercion (which does not presuppose their prior adherence) or incentive mechanisms based on private motivations (bonuses or tax relief) which are external to the purpose of these policies. The liberal approach will retain the image of the market as a process whereby particular interests are brought together in an overall equilibrium favourable to society. Beyond the fact that the process by which these interests are organised is obscure (the invisible hand), it should be noted that neither the republican nor the liberal vision bases the coordination of collective actions on the idea of a common purpose shared by the individuals concerned.'

Following this line of thought in *Dynamiques du Commun: entre État, Marché et Société* (2021), the authors add:

> 'Another manner of putting it would be to say that republican and liberal anthropological conceptions both exclude the possibility for humans to coordinate around the shared perspective of a common good, in line with the thought expressed by Plautus, subsequently taken up by Bacon and Hobbes that "Man is a wolf to man". The same understanding of humankind underpins Hardin's tragedy of the commons. Understanding the dynamics of the commons, therefore, requires overcoming the anthropological foundations of the State and the Market, respectively. Moreover, it calls for clarifying the notion of civil society, which is usually associated with the idea of collateral participation in public affairs.'

In addition to this dichotomy between the public and the private, the general interest and individual interest, which shapes contemporary institutions and limits their ability to provide solutions to cross-cutting problems and issues, there is another dichotomy, just as damaging in its effects, which the anthropologist Philippe Descola has brought to light. In showing that the great divide between nature and culture stems from

an obsolete ontology and that it is by no means universal, the anthropologist invites us to rethink the dynamics of collectives by including not only humans but also non-human beings. The result is a considerable shift in perspective. In 'naturalist ontology', viewing biodiversity as a common good or heritage had two possible consequences: either biodiversity was taken as a common good per se—hence, the conventional rationale of protecting non-human living things—or the poorly identified 'in common' dimension ended up dissolving into areas of individual and collective appropriation and responsibility, with the result that the transappropriative and circulating nature of living things were abandoned or forgotten.

However, it is difficult to break free from this socio-political and conceptual heritage, as the anthropologist pointed out in his book *La Composition des mondes* (2014):

> 'Conveying the idea of a complex assemblage of humans and non-humans to institutions deeply rooted in the Western religious and legal tradition is arduous, and achieving this requires considerable conceptual effort. We can no doubt compare this to the endeavours of nineteenth century thinkers of socialism who also aimed for a radical redefinition of the political categories bequeathed by tradition. In both cases, the challenge is to transcend the categories that initially enabled a form of emancipation linked to the Enlightenment and the French Revolution and achieve another form of emancipation commensurate with the assemblages of humans and non-humans that make up the different worlds.'

The implications, however, are not insignificant. Supposing biodiversity or some of its components are not just external or exogenous elements to human communities that are solely preoccupied with social issues but are stakeholders in these communities, contributing fully to their existence and helping them to structure and sustain themselves over the long term, then, a completely new outlook will emerge. Biodiversity or some of its components fall within the scope of individual or human group heritage, as defined by Henry Ollagnon (2003): 'all the tangible and intangible elements which, for a beneficiary, contribute to maintaining and developing his identity and autonomy by adapting to an evolving universe'. Henceforth, it is possible to capitalise on the heritage dimension of biodiversity to address it under certain conditions:

> 'Ergo, it does not seem unrealistic in the long term to dynamically maintain biodiversity by actively involving humans. In other words, to counter the pressure of degradation, a constructive counter-pressure must be created, an active responsibility for biodiversity, which is the only way to maintain and perhaps improve it.'

Criticism review

Reviewing the criticisms of biodiversity governance is no easy task for two reasons. Firstly, this is a fairly new development in the international process, at least in its stated and public expression. While this expression reflects an awareness of the problem and a desire to tackle it, it does not necessarily—or yet—translate into specific actions that can be assessed in scope and effectiveness. Secondly, this field has not been explored much by the social sciences: there is little research on the subject compared with the strategic directions mentioned above.

Nevertheless, three lines of criticism stand out, and it is difficult to say to what extent they are echoed by more than the few researchers and observers who voice them. The first line consists in doubting that international governance alone has the necessary resources to achieve a highly integrated approach to biodiversity management. The hopes nature conservationists and environmentalists place in this area perplex observers and commentators who, by contrast, emphasise the difficulties experienced by multilateralism and the fragmentation of international structures and approaches, including in the environmental field alone. Some people further point out that biodiversity does not have the same characteristics as climate, i.e. a degree of consistency and unity likely to encourage a unitary and global approach.

The second line of criticism, which stems more specifically from analyses carried out in the social sciences, concerns what could be described as a bias in the current international governance process. Researchers have highlighted that international negotiations still do not accord much importance to various stakeholders such as indigenous populations, small stakeholders, southern countries, etc. As a result, the concepts conveyed by the UN process tend to be based on Western-inspired interpretations and modes of action. Thus, the pursuit of a more accomplished and integrated form of governance would be dominated, consciously or unconsciously, by the standards of thought and action of the Global North. Finally, a few people have emphasised the extent to which the binary approaches commonly used to oppose the global to the local have led to ignorance of the meso-territorial level. This omission is difficult to understand when many territorial initiatives are being developed to improve the state of biodiversity and are proving somewhat successful.

A final line of criticism, rarer and more radical but no less potentially significant, points to the major omissions inherent in the emphasis on

regulation and top-down governance. The structuring of international negotiations, which gravitates around the individual/collective, personal interest/general interest, and public/private dichotomies, more or less completely misses the field of the commons. This is undoubtedly a paradoxical situation when, at the same time, biodiversity is regularly elevated to the rank of 'common good of humanity'.

Producing and consuming differently at the risk of standardisation

Reviewing the criticisms of the 'Produce and consume differently' direction is a difficult task to carry out. Although the seeds of this approach have been sown in international debates and texts since the beginning of the Convention on Biological Diversity, it only recently acquired a certain consistency in international negotiations. Only when conventional modes of production and consumption were sufficiently challenged in the social debate did potential alternative models become publicised.

Another challenge is that alternative models are sometimes still at the experimental stage or have not yet spread. Consequently, it is still too early to comment on them. Will they hold their promises? Will they offer sufficient long-term benefits to overturn the dominant models, which are considered obsolete or downright incompatible with 'planetary limits'? Once they are in place, will they not reveal a series of drawbacks or undesirable effects that had not been anticipated?

A final complication is that, faced with the ecological crisis, some players are in a hurry to act and rely on what they call solutions. The urge to break away from the existing system and the perceived urgency to 'change the system' do not necessarily foster reflection and perspective on the possible limitations of these alternative models. Given the circumstances, criticism is still tentative.

Despite these genuine difficulties, several findings, studies and research suggest that matters are probably not as simple as militant rhetoric would have us believe.

A change of model that is far less easy and fast than expected

Many commentators, experts and militants highlight that such radical changes in production and consumption modes are not an option but a

strict necessity. The industrial agrifood system offers a spectacular illustration of this: it alone accounts for a third of greenhouse gas emissions (Tubiello *et al.*, 2015); it causes a host of environmental damage, from the loss of a significant proportion of biodiversity due to the destruction of forests and grasslands to make way for new farmland, to the pollution of land, rivers and seas from agrochemicals and animal waste (Zhang *et al.*, 2015). As a result, many experts are responsible for the following diagnosis, 'Fundamentally, intensive agriculture has neglected and even disrupted the biology and natural capital on which the food production system has been historically based.' (Horton, 2017)

While some may conclude it is imperative to 'change the model', the path is not as easy as they might like. It presents several significant obstacles.

First, despite many technical innovations, in-depth research is still needed to develop effective alternative models. For example, while it has been possible to replace certain plant protection substances with others that are apparently less harmful, it is not always possible to dispense with certain problematic molecules in the event of severe pest attacks; a recent illustration of this is the use of neonicotinoids to combat sugar beet yellows. On another scale, agroforestry, despite its promises and encouraging results in particular soil and climate conditions, still faces severe technical obstacles that are delaying its widespread use (Reyniers, 2019; Grandgirard *et al.*, 2019). Similarly, biodynamic or permaculture practices, although they are manifestly conclusive in specific soil and climate contexts, would not present the same technical and socio-economic feasibility in other contexts and on larger scales.

Besides technical constraints, socio-economic, ergonomic, logistical, aesthetic and ethical constraints should also be considered … As research in the sociology of innovation and evolutionary economics has demonstrated (Akrich *et al.*, 2002; Gaglio, 2011; Callon, 2013), the intrinsic value of a technical model is not enough to warrant its widespread adoption. There is a long list of obligations and constraints that a technical model must meet if it is to succeed in dethroning a previous model.

Economist Harold Levrel (2020) has remarked that the intrinsic complexity of nature-based solutions makes them difficult to spread and exploit on a large scale:

> 'The goods and services derived from nature-based solutions result from complex production processes, which should be viewed in the context of the diversity of the socio-ecosystemic conditions in which they emerged. Moreover, in most cases, their productive potential can only be expressed after many years, which is

> unsuited to the short-term logics of economic and political players. The underlying issue, which should be seen as the root cause of the lack of private investment in biodiversity conservation, is that biodiversity primarily generates public benefits that are difficult to value on the market.'

In addition, one must reckon with a lock-in phenomenon linked to the history and strategic choices that were made at a given time: existing models have succeeded in structuring an action ecosystem which in turn grants them a certain dominance. Consequently, new models often involve considerable entry costs to secure a foothold; obstacles, there are resistance and barriers that are more or less easy to overcome and can constitute powerful obstacles to the evolution of technical and economic systems or, at any rate, considerably delay the adoption of new models, despite the real advantages these may offer. In the fields of energy and agriculture, for example, public funding and taxation continue to benefit conventional models to a large extent (Sainteny *et al.*, 2012; Kirsch *et al.*, 2017); the effects induced by decades of public funding do not disappear overnight, and new technical models, from organic farming to renewable energies, only succeed in reorienting the budgetary and institutional infrastructure that spontaneously favours the dominant models at the expense of new entrants. In France, for example, a research group specialising in evolutionary economics has set out to elucidate the reasons why legumes are struggling to make inroads into an agricultural system that is primarily dominated by cereals, even though they offer proven environmental and nutritional benefits:

> 'Initial agricultural choices tend to be self-reinforcing over time, mediated by a variety of socio-economic mechanisms that together have shaped the increasing yields of adoption. … Therefore, although grain legumes (grown alone or in combination) offer agroecological advantages (particularly in terms of nitrogen management), they are rarely found in conventional cropping systems. After having initially been overlooked in comparison with the more significant investment in other crops (upstream and downstream of the supply chain, particularly for industrial uses), the difficulties that farmers may encounter with their produce (i.e. irregular yields and pest issues) are now perceived as even more critical with respect to the spectacular improvements that have been made to other species. As a result, the conventional farming system has gradually established a divide between 'major' and 'minor' species. The latter are now experiencing increased competitiveness issues, which public funding can no longer counterbalance with "crop-specific incentives".' (Magrini *et al.*, 2016)

A final objection consists in relativising the scope of alternative models on the grounds of the structure of the global economic system itself

and, more profoundly, the cognitive and imaginary structure that permeates humanity as a whole. Compared to major trends and material flow, the share of alternative models remains extremely low (a few per cent at most). The surface area of land dominated by agribusiness continues to grow, as does global meat consumption, boosted in particular by the appetite of the Chinese population. As for disruptive technologies meant to reduce the ecological footprint, their massive use of digital technology does not guarantee lower greenhouse gas emissions.

Given this state of affairs, it is vital to resist what some people call 'techno-solutionism', which has been rekindled of late by the digital hype, the prospects offered by 'revolutionary' technologies and the loud promises of a few 'high-tech billionaires', as engineer Philippe Bihouix pointed out (2019):

> 'But we must—and we actually pretend to want to—curb the unsustainable rate at which we exploit resources and contaminate the planet. To that end, we must rethink innovation and steer it towards saving resources and preserving ecosystems, or at the very least sorting them out like the wise men of Solomon's House on the island of New Atlantis. Unfortunately, we are not going down that road: instead of carefully stepping on the brakes …, we are putting our foot down with delight—or fatalism …—despite all the fine talk about sustainable development, circular economy, energy transition, and the (distant) targets that have been heralded. We will have to face a gigantic acceleration, at least according to predictions. The immediate acceleration of the Internet of Things and related Big Data and, more prospectively, of various disruptive technologies.'

In the same vein, economists and engineers have issued warnings about the rebound effect of the 'energy efficiency paradox'. As Benoît Ploux and Jenny Dujeux (2019) have observed:

> 'One of the consequences of globalisation is that a large part of polluting extraction and production now occurs beyond our immediate environment, often beyond our borders. This is essentially a rebound effect: improvements in our local environment drive us to consume more because we do not feel the consequences directly.'

As a consequence, while many energy scenarios assume that new energy sources will replace fossil fuels and ease the ecological footprint of human activities, the rebound effect could invalidate these optimistic scenarios since 'investments in efficient systems drive change in human behaviour, which becomes less frugal and will need to be curtailed again to achieve real energy savings'.

Finally, many economists, sociologists and philosophers have observed that, despite repeated warnings about the threats of biodiversity loss and climate change, the actual behaviour of most human beings and the dominant economic circuits and financial flows is still largely dependent on and attached to potentially harmful modes of production and consumption. Fossil fuel dependence is most probably the most striking illustration of this. As long as the driving force remains the pursuit of economic and demographic growth, some believe that breaking away from productivism and consumerism will be complicated and that developing gentler production and consumption models will probably be insufficient to right the situation.

The risk of a new form of one-track thinking

Entertaining the belief that some production modes are intrinsically virtuous can have perverse effects that are as unexpected as they are regrettable. One of the most common perverse effects identified is that the systematisation or over-generalisation of a model promoted as a panacea can, in turn, become problematic. Wind power is an example of a 'solution' which, once it has crossed a certain penetration threshold, can become, at least for certain stakeholders, worse than the evil it was meant to fight. In France, for example, after substantial development in several regions, wind power is now opposed by various stakeholders, who accuse it of damaging the quality of the landscape and causing noise pollution. Similarly, organic tomato farming in vast expanses of greenhouses, as is the case in Andalusia, generates a series of upsets at the expense of local biodiversity. The value of a technical model should thus also be assessed as a function of how it fits into the landscape and the extent to which it is systemised, something which is often overlooked in the frantic search for alternative technical solutions.

After enjoying considerable growth, energy crops— some of which, such as rapeseed in Europe, offered undeniable benefits in agronomic rotation—eventually destabilised food markets. Equally, the popularity of superfoods such as quinoa and avocado has destabilised some rural economies by driving up the price of staple foods and intensifying the clearing of natural forests to conquer new production areas. This process has been well described by Richard Raymond (2018) with regard to quinoa:

> 'This success has brought substantial income to many families in the Andean Altiplano and significantly improved their standard of living. However, the

> formidable increase in quinoa farming is also happening at the expense of the environment and social cohesions. The expansion of farmland is happening at the cost of pastureland. Cultivated areas are spreading over the plains. At lower heights, crops are more exposed to night frosts. Soils are weakened and more vulnerable to erosion. Village communities are falling apart due to the competition for land use …'

Furthermore, with avocado farming in Mexico, the green gold has been hijacked by cartels; after a favourable period when they could make a decent living from their crop, small growers now see their situation as a real curse, being forced to produce more and more for insufficient residual income and with a stranglehold on their production systems by organised crime (Thiébaut, 2009; Frey et Laisney, 2021). Therefore, the intrinsic virtue of a production system is not a guarantee of global quality. Many examples show how the spectacular success of ecologically positive models backfires on their promoters. As soon as it becomes hegemonic and conquers a vast space, a model that is a priori virtuous can become harmful to diversity. Hence, the ecological virtue of a model does not systematically warrant the sustainable nature of a production system. In Germany, for example, organic dairy farmers routinely face overproduction issues, which places them in the same financial predicament as their colleagues who produce conventionally (Briot *et al.*, 2017). One of the consequences of this is the increase in the size of organic herds, which runs counter to diversity in farms and production sites.

Another set of perverse effects arises from the development of standardisation, certification and quality-label guidelines. Whether public or private, these standards are often presented as a means to foster the differentiation between conventional and sustainable production methods or, in any case, to check demanding specifications, particularly in environmental or social terms. One of the first shortcomings of such systems is that they focus primarily on environmental performance rather than on sustainability as a continuous improvement process, which necessarily fluctuates with socio-economic and political context. The second shortcoming is the potentially high cost of certification and quality-label systems, which tends to disadvantage small producers compared to larger operators who are in a better position to absorb the additional cost of these procedures within their overall cost structure. Thirdly, such systems can de facto lead to the uniformisation of cultivation modes. As obtaining the quality label becomes a condition of access to the market, producers comply with specifications that tend to prescribe monolithic visions of what 'good'

forest sustainability is, for example. These different scenarios can result in the standardisation of production methods, which goes against the plurality of situations and management methods that are nevertheless the source of greater biodiversity. In short, this amounts to a new form of one-size-fits-all approach that belies diversity.

The matter of norms and standards also explains why legal, safety or health considerations, for example, and ethical or symbolic considerations, may shape dominant modes of production and consumption more than constraints or technical innovations. In theory, technical models that might be more beneficial to biodiversity may well end up being disqualified because they do not comply with current standardisation systems or are too complex to adapt to worker safety requirements, for example. By focusing on the technical systems and models themselves, the risk is high of failing to tackle, head-on, processes that are more difficult to grasp and which have a significant impact on the field of possibilities. In other words, looking at the transformation of production and consumption modes primarily from a technical angle may seem like an easy solution, even a false solution, insofar as it diverts attention from the more difficult issues to address, which involve the complex processes behind the definition of norms and quality standards and determine the real areas of constraint on which the development potential of the various technical systems depends.

Lastly, market operators and economists have remarked that it is essential not to rush into things and take time to assess the overall situation before deciding that alternative models are manifestly superior. Although they do not deny that production and consumption modes deserve reconsideration, they also urge caution. Firstly, it would be unwise to 'get carried away' about so-called technical solutions that might, sooner or later, prove severely dysfunctional. Secondly, it is essential to refrain from condemning certain modes of production and consumption out of hand, as they also offer real advantages, provide food and a livelihood for many people around the world, have helped to lift people out of poverty and hunger, and are still highly effective in today's economic and social structure. Some are, therefore, wary of ready-made solutions, of models deemed intrinsically virtuous or even ideal, because they fear that this may be to the detriment of a certain form of freedom and the plurality of possible formats. Taking the argument further, others lament that this is a form of idealism and argue in favour of pragmatism. They take a cautious view of rhetorics that claim to invalidate production and consumption modes, which are readily equated with unbridled capitalism or liberalism. They call for a

full assessment of the models by drawing up a detailed inventory of their pros and cons and a retrospective analysis. Moreover, they remain vigilant, fearing that appeals to change systems radically may not prove a priori that the replacement system—which, moreover, is difficult to picture—is as commendable when put to the test as the one that is to be abandoned. For example, geographer Sylvie Brunel (2020), using the example of Andalusia, warns against pitting different agricultural models against one another:

> 'Overwhelmed by the sea of plastic greenhouses where immigrant workers are exploited, and desertification is taking hold on overused land, Andalusia is now trying to introduce sustainability criteria, particularly in water management. The Alvela movement, born in 2014, advocates for regenerative farming to restore ecosystems and resurrect abandoned villages. … However, the project is financed by a Dutch foundation, Commonland, which invested 26 million euro for less than 300 farms. And the yields from rye planted using these regenerative methods are 1.2 tonnes per hectare, barely more than that harvested by African farmers. Again, the cost of one tonne of food is prohibitive compared with the sums collected.'

The need for new forms of contractualisation

Beyond the limited or dubious capacity of alternative models to supplant conventional models, beyond the adverse effects and risks associated with new forms of standardising production methods, which certain organised and powerful economic players will undoubtedly be in a better position to leverage at the expense of small-scale producers, there is another, even more fundamental, limitation. For various observers and researchers, the changes in production and consumption patterns are mainly being played out in another arena. As Richard Raymond (2018) has pointed out:

> 'While these technical and normative responses have encouraged some progress, they do not challenge the agro-industrial system's logic and its mechanical and simplifying approach to the diversity of agricultural practices.'

Admittedly, this development implies the availability of new technical references and alternative models that have proved their worth and are ideally suited to different socio-economic contexts. But unless there is a profound change in the producer-consumer relationship, a fundamental redefinition of the contract or contracts that bind them, and more generally, a comprehensive redefinition of the social contract on a national scale (Dugué *et al.*, 2011) and perhaps also on a global scale, there is a real risk that technological innovation efforts will stall.

This is already apparent, albeit on a modest scale, in the development of the French AMAP (associations for preserving peasant agriculture), fair trade, free software, the solidarity economy, etc. These different forms of alternative consumption and production call for new contracts between stakeholders based on shared objectives and negotiated voluntarily between the members of the communities concerned.

On a larger scale, new public policies must be developed, bearing in mind that the competitiveness of production systems is a critical factor that should not be underestimated. As Sylvie Brunel (2020) has suggested:

> 'Moving upmarket, as the public authorities advocate, will not help French agriculture withstand international competition and internal difficulties. Price competitiveness is increasingly challenging to maintain in open markets, and the reorientation of French agriculture to focus on the trilogy of environmental sustainability, taste, and health safety is only financially viable for farmers who benefit from solid, remunerative contractual arrangements over sufficiently long periods to justify the necessary investments and the drop in production. And in any case, they will need substantial financial support.'

In a vast review of the pros and cons of nature-based solutions (Seddon *et al.*, 2020), a group of environmental scientists has argued in favour of the need for a new political and strategic framework to ensure these solutions fulfil their promises:

> 'Fully integrating nature-based solutions as solutions to both the climate and biodiversity crises requires a new approach in economic thinking, shifting from a focus on infinite economic growth to a recognition that the energy and material flows needed for human well-being must remain within safe biophysical limits. … However, their benefits will not be realised unless they are implemented within a systems-thinking framework that accounts for multiple ecosystem services and recognises trade-offs among them from the perspectives of different stakeholders. As nations revise their climate policies (Nationally Determined Contributions), and climate policy increasingly turns towards greenhouse gas removal approaches to help achieve climate targets, further elucidation of this systematic framework should be an urgent priority for future research.'

Thus, it would appear that technical solutions and biodiversity-friendly production and consumption models cannot be achieved without a new interaction framework between players, producers, consumers, and all the stakeholders in the production and processing chains. New contract forms between players should be developed to share risks, ensure fairer remuneration for producers and seek synergies, barring which no technical model can produce the desired effects. In addition to technical

aspects, production and consumption patterns changes include an irreducible political component.

Criticism review

Ever since the responsibility of production and consumption patterns in the deterioration of environmental parameters was directly incriminated, the propensity of many leaders, observers and researchers has been to hope that—intrinsically virtuous—technical solutions would be able to replace conventional models. Biodiversity is no exception, judging by the high expectations placed, in particular, on nature-based solutions. Such an attitude has several roots: it capitalises on the still high level of confidence in the development of science and technology; it seems as neutral and painless as possible because the difficulty has shifted to the technical arena; it suggests that revisiting ancestral techniques or innovations that leverage modern technologies will enable everyone to live better, without the need to change our way of life fundamentally.

However, the criticisms mentioned in the previous pages show how debatable this attitude can be. It is somewhat naïve to rely mainly on overhauling technical models to achieve significant changes in production and consumption patterns. Not only are there often major hurdles and roadblocks to the breakthrough of new models, but following the emergence of new technical models, failing adequate attention and regulation, unexpected and unfortunate effects may occur. More than that, typically, the transformation of production and consumption modes cannot be reduced to technical considerations; it presupposes a change in the relationships between people, producers and consumers, for example. Consequently, new organisation and solidarity modes between stakeholders would be required for a truly beneficial change to happen. In summary, acceptance and legitimacy of technical change typically call for equally in-depth and determined political and economic transformation.

In short, the flaw of the current strategic direction stems from overinvesting technical solutions in their capacity to positively change production and consumption patterns. It places its hopes on the advent of new models or standards and their mainstreaming. Standardisation encompasses the idea of a technical solution, a set of specifications and a frame of reference that eventually emerges as the imperative norm or standard, a form of action that is insufficient to bring about a profound transformation in production and consumption patterns.

Conclusion

The first part of our book demonstrated that international strategy to fight biodiversity loss stems from a diagnosis that gravitates around three major principles and rests on five main pillars or levers for action. These pillars, which serve as strategic directions, are not entirely explicit. However, although different expert and stakeholder communities support them, they are rarely debated.

This is not true, however, of the preferred modes of action for these five strategic directions, as the many criticisms and limitations reviewed in this section have shown. We have sought to present a broad range of these criticisms and limitations without claiming to be exhaustive. We have also tried to organise them to encourage readers to step back and appreciate their profound meaning.

The time has now come to compare what we have learnt from these two sections and to infer some considerations of a more general nature. First, a cross-sectional review of the criticisms and limitations will enable us to look back at the official diagnosis, its benefits, simplifications and shortcomings. It also implicitly suggests that a more comprehensive and satisfactory approach to fighting biodiversity loss is within reach. With this in mind, developing a fresh strategic diagnosis is essential, building on the criticisms and limitations identified regarding the current methods of action and their profound implications.

KEYS FOR RETHINKING THE STRATEGIC APPROACH

'Anyone who hasn't seen the road at dawn between two rows of trees, so fresh and alive, knows nothing of hope. Hope is the heroic determination of the soul, and its noblest form is despair overcome.'

Georges Bernanos, 1944

Faced with the damning diagnosis of human responsibility for biodiversity loss, the prevailing argument calls for changing course as quickly as possible. Choosing life means leaving behind the deadly mode of development in which humanity has embarked. We are told that the solutions are known: now, we need the necessary clarity, fortitude and political will to break away from the 'business as usual' model by taking the 'necessary measures' without delay.

This way of putting things has become such a familiar refrain that it no longer surprises anyone. Everyone has become accustomed to it. In their efforts to raise awareness of the challenges posed by biodiversity loss, leading specialists have dramatised the issue; official national and international strategies have canonised it in their preambles and 'summaries for policymakers'; films, documentaries and news reports have systematised it; and educational literature, from primary school to higher education, has popularised it. It has become hard to escape, 'the' standard way of presenting the issue.

Undeniably, this approach to the crisis is based on indisputable facts, analyses and studies. Nonetheless, as the previous section has shown, there is a wealth of research and debate on the merits and limitations of official strategic directions, which should be given more attention. As various stakeholder groups and epistemic communities produce these analyses, they are often sparse and fragmented. To this day, UN bodies and international negotiation have not really leveraged them to draw up any

kind of review or global assessment of the effectiveness of the directions and measures adopted to fight biodiversity loss.

First criticism overview

This is why we have attempted to produce an initial assessment of this type ourselves. The task is an arduous one, with research evolving on an almost daily basis. Consequently, this overview certainly deserves to be discussed, enriched and updated. We have only provided an outline —Figure 13 offers a schematic representation—by organising it around each of the five major directions of international strategic action. What conclusions can be drawn from the criticisms and limitations of these five dominant trends?

As regards the 'protect-preserve' approach, the dominant rationale is to sanctuarise. It harbours the seeds of many perverse effects. Indeed, to sanctuarise means to sacralise, more or less voluntarily and consciously, remarkable biodiversity at the expense of ordinary biodiversity. To sanctuarise also means spatially and socially isolating a territory from its environment. Lastly, to sanctuarise an area, like a budget, removes it from debate and discussion, making it intangible and ensuring its security, but perhaps at the cost of its ecological and social dynamics. Consequently, this approach stems from a rationale that separates and removes. Such a rationale makes it challenging to address ordinary and remarkable biodiversity simultaneously, although this is essential. It divides and freezes spaces in a world where species mobility is and will be increasingly essential. It impedes synergies between stakeholders, notably by limiting the role of local players. It contributes to entrenching the divide between humans and non-humans, where the latter must be kept at a distance from the former at a time when our societies express the need to 'reconnect with nature'. In the final analysis, it is a sector-based approach. The results may have been beneficial locally; nevertheless, it seems limited and unable to respond to the challenge of biodiversity dwindling everywhere, a loss that affects all areas and requires mobilisation far beyond the existing circles of conservation stakeholders.

For the 'know-mobilise' strategic direction, it takes nothing away from the merit and importance of scientific work to recognise that it has neither the capacity to tell the whole truth nor the ability to say everything that must be done; that expecting science to provide 'solutions' impoverishes the infinite diversity of relationships within the living world, which

cannot be reduced to the order of knowledge and objectification. Excessive hopes placed in science are sometimes fraught with consequences, both in terms of mobilisation and of the link between science and politics. This is all the more obvious as biodiversity loss is a highly complex and rich issue that cannot be addressed exclusively through technical or scientific responses. Practically speaking, however, the 'rationalisation of nature' and de facto monopolisation of the international debate by cenacles of experts from the conservation sciences have resulted in the primacy of the commodification of biodiversity. Biological and ecological data largely prevail, while the diversity and density of human relationships with various forms of living things occupy a derisory place. This commodification process transforms a fluid, dynamic reality often closely related to human activities into an 'object in itself', something impersonal that can be studied scientifically. What emerges then is a form of dehumanisation of biodiversity, the abstraction of a reality that cannot be reduced to its materiality. Henceforth, the only avenues for engaging stakeholders are supposed to be awareness and education.

As for the 'value-incite' strategic direction, the monetisation rationale has prevailed quite distinctly. However, by assigning a monetary value to an asset, we have insensibly moved towards monetisation, whereby a good is reduced to its monetary value. The distinction may seem minimal, yet through this gradual (and fortunately still challenged) shift, a complex strategic direction is transformed into a dominant—and worrisome—mode of action. Indeed, monetisation appears as a potential source of significant imbalances, undermining the goal of effectively fighting biodiversity loss. In its quest for efficiency, this approach tends to stand out as 'the solution', to the detriment of other forms of action and at the risk of commodifying living things. It is fraught with inequality and spatial and social injustice. Unable to embrace the complexity of living things, it often results in systems that freeze, separate and reduce the living world. It undermines the human dimensions of action, the capacity for selfless commitment, the possibility of building commons and a balanced relationship with others (human and non-human). Its most significant flaw is that it primarily fosters the commercial motivations of players and agents without acknowledging the existence of intrinsic motivations behind active, free, and voluntary care of living things.

Regarding the 'regulate-integrate' strategic direction, international negotiations in favour of biodiversity are doubtlessly valuable and necessary for an issue of this importance, which often has transboundary

and cross-cutting dimensions. Similarly, the search for greater integration between various public policies certainly corresponds to a favourable development in global governance. Yet, the temptation to manage the issue of biodiversity loss mainly from the top down, between 'global players', should be resisted. Many aspects of biodiversity operate on different scales and involve many other stakeholders, factors and complex processes. In recognising the States as the only legitimate players, the UN process favours the globalisation model to establish a global strategy to fight biodiversity loss. This dominant model is problematic insofar as it leaves very little room for other players: it overshadows the diversity of situations and contexts with the imperious need for a global diagnosis and goals. It fails to recognise the importance of the meso-territorial level in caring for living things. As a result, it also depends on the modes of action and tools available to governments. Still, it has trouble engaging other players and the specific levers for change they could provide. The risk is that biodiversity will not be perceived as a common heritage of humanity but as a problem of individual states.

Regarding the 'produce-consume differently' strategic direction, the necessity to develop new technical systems with a less damaging ecological and climatic footprint is becoming increasingly apparent every day. International negotiations on biodiversity are thus justified in attaching greater importance to this strategic direction, even if, unlike previous orientations, it undoubtedly has less room for manoeuvre. This limited capacity to weigh directly on production and consumption modes partly accounts for the international process's tendency to place its hopes in the emergence of technical models, supposedly intrinsically virtuous, and notably nature-based solutions; In prioritising a technicist response and acting as if certain models would radically change production and consumption patterns on their own, the UN process relies mainly on standardisation. This approach reflects a form of ingenuity: technical systems that are a priori more satisfactory from an ecological point of view may come up against a series of obstacles that stand in the way of their generalisation; perverse effects are also likely, as new forms of ecological requirements and standards may lead to the simplification of production systems, which would be ultimately detrimental to biodiversity itself. Most of all, the focus on technical models and solutions neglects the social and political aspects of the issue: production and consumption patterns are also, and perhaps above all, a reflection of the current state of

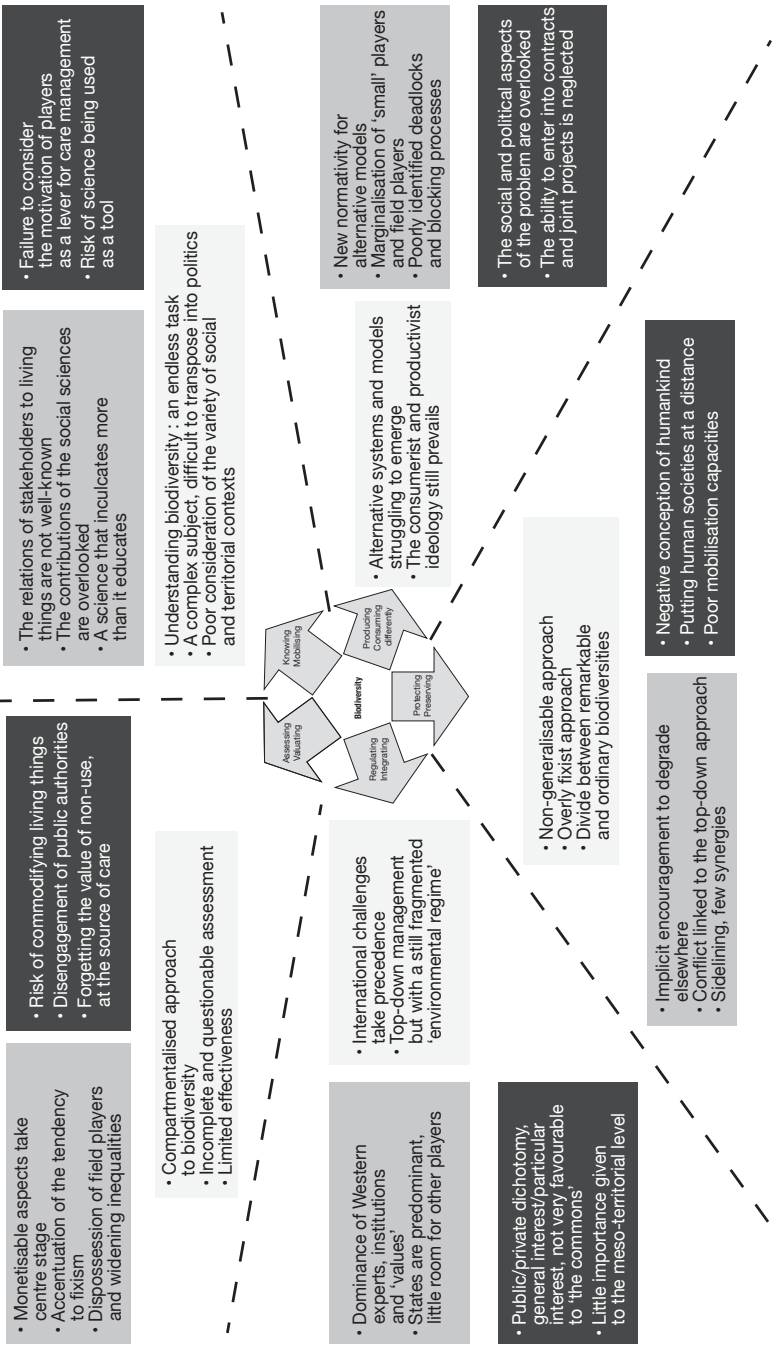

Figure 13. Overview of the criticisms of the global biodiversity strategy: in light grey, limitations; in medium grey, adverse effects; in dark grey, omissions or setbacks (© Brédif and Simon, 2021).

agreements and contracts between the different members of our societies, and of their ability to work together or not.

This review of the criticisms and limitations of each of the five main directions of international biodiversity strategic action provides some key lessons. In each strategic direction, the criticisms expressed may be grouped into three sets:

– limitations;
– actual or feared paradoxical effects;
– setbacks or significant omissions.

The repetition of this pattern across the five strategic areas identified is quite remarkable given that the problems, undesirable effects or omissions mentioned have less to do with the strategic directions than with the favoured action mode through which each direction is expressed and affirmed. Over time, this action mode has become dominant and even overwhelming, to the point where it, in turn, causes a series of difficulties and disorders, either because it is viewed as the solution to the problem at hand or because it generates a series of undesirable or perverse effects, or because it is rolled out at the expense of other action modes that fail to make inroads.

A simplistic and flawed diagnosis

In contrast, this panorama of criticisms and limitations sheds new light on the habitual diagnosis of biodiversity loss. It is a diagnosis often used by experts, specialists and stakeholders in opinion columns to try, in good faith, to draw attention to the biodiversity crisis. It is an official diagnosis which is undoubtedly based on some alarming figures and trends but conveys a strangely bleak, poor and crude image of reality built around a few recurring themes.

Humans in general, or human activities as a whole, are most often incriminated without any real distinction. Although rigorous research and in-depth studies have more precisely identified specific production methods, practices or development methods (intensive agriculture, industrial fishing, noise and acoustic pollution, etc.) as the cause of the damage brought to biodiversity-rich natural environments, the general rhetoric, conveyed by official texts and a fortiori by the mainstream media, has little use for such nuances. While global warming specialists and climate conferences have adopted the principle of differentiated responsibility, their counterparts in biodiversity loss are satisfied with the generalised responsibility principle.

While the former believe that the responsibility for greenhouse gas effects differs according to States, economic models and industries, ecologists, conservation biologists and other nature defenders do not deem it worthwhile to introduce such differences, especially as they have not had to fight 'biodiversity sceptics'. In fact, they feel that the situation is so critical and the cause of biodiversity so inadequately recognised that they find it acceptable to generalise the diagnosis of anthropogenic impacts.

From one place to another, the issue of biodiversity loss is as acute as ever, and the terms used are the same: it is a global issue. In a way, saying that the climate is a global problem can be justified by the unicity of the atmosphere: the physical reality of the phenomenon, its circulation on a planetary scale, which de facto includes the various local greenhouse gas emissions, lends credence to the statement. However, transposing it incautiously to biodiversity is a rather delicate endeavour given the diversity of biodiversities; the variety of the relationships between living things and inherent issues depending on geographical, social and economic contexts and political regimes, and the questionable possibility of achieving a unified interpretation of biodiversity, a fortiori of finding the origin of biodiversity loss.

The main causes of this phenomenon are well known. Yet how can we believe that the five factors, traditionally grouped under the acronym HIPPO-C, correspond to primary or ultimate causes, the root of the evil, whose extraction or devitalisation would help curb the phenomenon (boxes 3 and 4)? In English, we use the term drivers to refer to these factors, making it clear that they are not so much causes in themselves as distribution belts and amplifiers of processes that are difficult to grasp. The Millennium Ecosystem Assessment's attempts to identify 'second-order drivers' highlight the difficulty of considering the problem in terms of a strict causal rationale, a cause-effect relationship that is as reassuring as it is predictable and controllable. In this respect, monographs and field studies have often provided much better evidence of the interconnection of different factors, the diversity of contexts and the need for caution when generalising conclusions.

The threats to the fabric of life are considerable, and the future of humanity is in jeopardy. As with climate change, but in a less obvious way, the prevailing rhetoric focuses on collective inaction. In focusing on past and actual losses and future threats, it dismisses the evidence of attachment to various forms of biodiversity and the highly positive evolutions in individual and collective relationships to living things. Admittedly, their local or

specific sphere of influence may seem insufficient or even derisory, given the rapid degradation of vast ecosystems. However, this testifies to a considerable and profound change in mindset and a no less remarkable desire to reverse the trends at work. This significant change in our relationship to the living world, described in particular by social science researchers, is difficult to reconcile with the general rhetoric, which is overwhelmingly pessimistic. Yet it does exist, and it is unreasonable to neglect it on the grounds that it is sporadic or patchy and, therefore, challenging to identify and account for.

The solutions are known; in practice, however, they are challenging to implement. Hence the emphasis placed on education and the considerable efforts made by biodiversity scientists to highlight the roles and values of biodiversity, mainly through the concept of ecosystem services. The point is to convince people, to draw attention to the issues at stake and the foreseeable costs of inaction, and in so doing, to help raise awareness. This, so that everyone, in their daily gestures and consumption patterns, should become more responsible; so that everyone, in their capacity as citizens, should seek to put pressure on policymakers so that decisions and measures that are not very easy to accept under normal circumstances may nevertheless prevail. Through this perspective, the five pillars of strategic action that stood out when looking at the action plans and strategies developed by the international negotiations on biological diversity are no longer noticeable. 'Awareness' and 'necessary measures' become the keywords for action[47].

This discursive pattern offers three advantages. It is simple, clear and consistent: it is a practical vademecum; it has a logical structure and draws on proven diagnostic elements; it is fairly consensual, or in any case, does not elicit any robust questioning. It is also broadly reported in the media. As an example, the 6 May 2019, editorial in *Le Monde* focused on the following sentences: 'But no one can ignore it any longer: the planet is heading for the sixth extinction. … With a single culprit: humankind. … This observation, made with the cold precision of science, places humanity face to face with its responsibilities, at least as much as global warming.

47. Published on 28 September 2020, two days before the first United Nations Biodiversity Summit, the four-page text entitled Leaders' Pledge for Nature is symptomatic of the view that the solutions are known and that only the will of policymakers will make a visible difference.

… The truth is that by undermining biodiversity, we are jeopardising our future. … The answer to the scientists' warning is now in the hands of governments.'

However, we believe it is fair to say that such a discursive pattern has severe drawbacks and collateral effects.

Given what is being written, thought and developed on biodiversity loss, it is extremely limited and reductive. Entire areas of thinking and experience are overlooked and dismissed.

Globalising to the extreme, it suggests that all biodiversity situations are equal and, above all, that universal solutions exist that depend only on the will of policymakers to be implemented and curb the issue. The result is a predominantly top-down approach, in which local players are, at best, seen as mere executors of a system designed from on high.

The messages it conveys, both explicit and implicit, are not very stimulating and undoubtedly fuel a deeper form of despair. Not only does it retain solely the bleakest elements of the diagnosis, but it also conveys that the relationship between humans and biodiversity is mostly degraded and detrimental. Humankind appears implicitly as a superpredator, a threat that is difficult to contain[48]. Worse still, the solutions advocated—the famous 'necessary measures'—seem so unrealistic and improbable that they cast further doubt on the possibility that the trend towards the depletion of living things might be curbed.

Therefore, it leads to desperate proposals. From Edward O. Wilson's *Half-Earth* (2016) to Virginie Maris's (2018) 'prefer not to: not build, not develop, not organise' philosophy, isn't it ultimately a question of saving what can still be saved in the face of a fundamentally bleak outlook? This is not a very reassuring perspective, which consists, at best, in limiting the ongoing tragedy.

Ultimately, the currently dominant formulation of the issue of biodiversity loss, its origins and associated threats is based on, de facto, a certain number of presuppositions, something its promoters or mere users are often unaware of. Together, they form an axiomatic framework that is insidious because it is not explicit. This integrated axiomatics appears

48. In this respect, we agree with Baptiste Morizot (2020b) when he suggests that what is being implemented is 'a grand narrative to explain the nature and cause of the ecological crisis. And this rising explanation, poised to triumph, to sweep aside any analytical finesse and historical nuances, is the fundamentally misanthropic explanation of a humanity destined to destroy the living world that supports it.'

through the following assumptions, which should be considered as forming a coherent and robust whole:
– Nature and biodiversity are a marvellous source of wealth and an irreplaceable potential. Human activities result in degrading this tremendous potential: they consume and misuse it. The relationship between humans and nature is essentially one of predation. Humans behave as an entropic force would, sowing chaos and devastation in their wake.
– The issue of biodiversity loss is well known, both in its characteristics and fundamental causes. Everyone agrees on the diagnosis. While it still needs to be fine-tuned, no significant changes are expected in this area.
– Because biodiversity loss is a global issue, it calls for a global solution.
– The severity of the situation calls for drastic changes, which require political courage and will.
– Human beings being what they are and human groups being what they are, we should first and foremost consider restrictive measures to reduce human impact and mitigate, if not halt, the erosion of living things.

A thoroughly renewed strategic diagnosis

In a text published in conjunction with the Johannesburg Earth Summit, Robert Barbault (2002) pointed out that the concept of biodiversity marked two significant epistemological breaks. In his view, the first is that it recognised the fundamental interdependence between the three main areas of the living realm, traditionally addressed by different specialists: genetic variability (geneticists), species diversity (systematists), and functional or ecological diversity (ecologists). The second is that the notion of biodiversity is not the exclusive preserve of biologists; in fact, the Convention on Biological Diversity was negotiated from the outset at the crossroads of multiple issues, rationales and conflicts of interest that the all-encompassing concept of sustainable development attempted to reconcile.

Our approach in this book consists in taking the second disruption evoked by Robert Barbault seriously. It takes a broad, open perspective on the issue of biodiversity loss, drawing on the wide range of research and thinking on the subject, without restrictions or a priori preferences. We believe we have identified several essential points by proceeding in this manner.

A close look at the recommendations for action issued by the various research communities and the framework documents produced for the

international negotiations on the Convention on Biological Diversity reveals five main strategic directions or areas of focus. However, this basic structure of strategic action is not entirely explicit, although it does surface, for example, in the Aichi Targets. The fact that there are fragmented research communities and that some disciplines (geography, anthropology, philosophy, social sciences other than economics) are under-represented in the bodies responsible for the appraisal process and the preliminary framing of issues and recommendations does nothing to help recognise this structure. On the other hand, diplomats involved in international negotiations can spot the different components more easily and sometimes instinctively.[49] The Millennium Ecosystem Assessment uses a pentagon shape to represent the consequences of various biodiversity evolution scenarios on the five components of human well-being. Figure 14 adapts this representation mode, placing the five key directions of official strategies at the centre. The commonly preferred action method is indicated in the margin for each of these primary strategic directions.

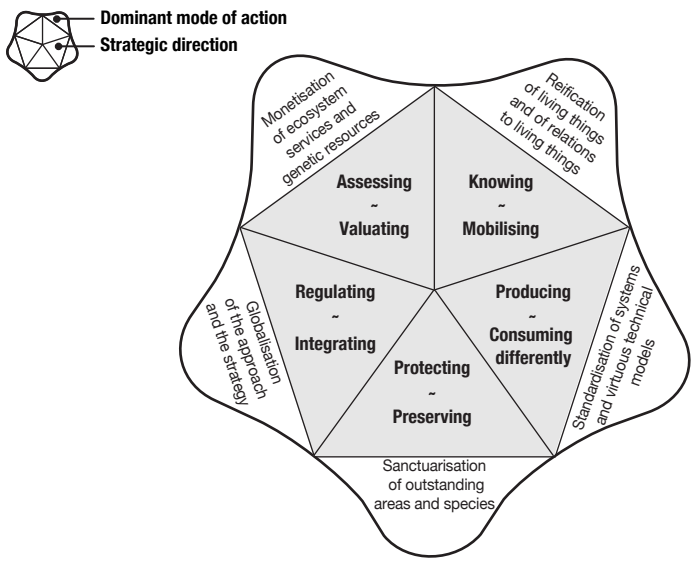

Figure 14. The underlying structure of international action against biodiversity loss (adapted from Brédif, 2016).

49. This empirical observation was made during private discussions with French and foreign negotiators, particularly during COP negotiations.

As the second section of the book showed, there is much criticism and challenge of policies, strategies and measures relating to biodiversity and the fight against its decline. A closer look, however, shows that it is not so much the strategic direction itself as the prevailing action method which is called into question. In turn, the latter poses a problem not so much for what it is or what it represents but for what it ignores, overlooks or de facto obliterates by virtue of its prominence. For each strategic direction, a specific mode of action monopolises most of the attention and resources, which is where the problem lies. Limitations, paradoxical effects and setbacks or omissions can thus be construed as three key classes of manifestations or symptoms that reflect the fundamental instability of a strategic direction based primarily on the preferred course of action. If the criticisms are levelled at the over-investment in the preferred mode of action for each major strategic direction, it is because another form of action is likely to correct or compensate for the undesirable effects of the dominant one. In fact, the criticisms suggest, often implicitly, that another form of action has been neglected. This is often more difficult to identify because it involves many players and factors. Specifically, it goes beyond the strict domain of biodiversity in its objective, intrinsic and dedicated dimension; as a result, it is not as easy to characterise. Although this complementary approach cannot be named outright, the criticisms and questions raised help identify which part of the issue or challenge behind each strategic direction has not been adequately addressed.

Thus, behind each strategic direction, a fundamental difficulty arises from the tension between two distinct and sometimes antagonistic, but nonetheless complementary, polarities or components (Figure 15). The challenge for each strategic direction lies in finding a balance between these two polarities: not a stable or static balance but a dynamic and adaptive one. Such is the overriding challenge that must be met: the reason why the erosion of biodiversity is proving so difficult to halt. Particularly as the pattern is repeated: there are no fewer than five dynamic equilibriums to be maintained, the relative importance of which probably varies depending on geography but which must always be considered. These five challenges constitute the issue of biodiversity; they are its fundamental expression. Updating them helps shed light on the misunderstanding around the official diagnosis. Seeking to identify the causes of biodiversity loss can, at best, help diagnose the state of biodiversity. It is a scientific diagnosis that measures the difference between a baseline state that is not always fully justified (the good health or good working order of an

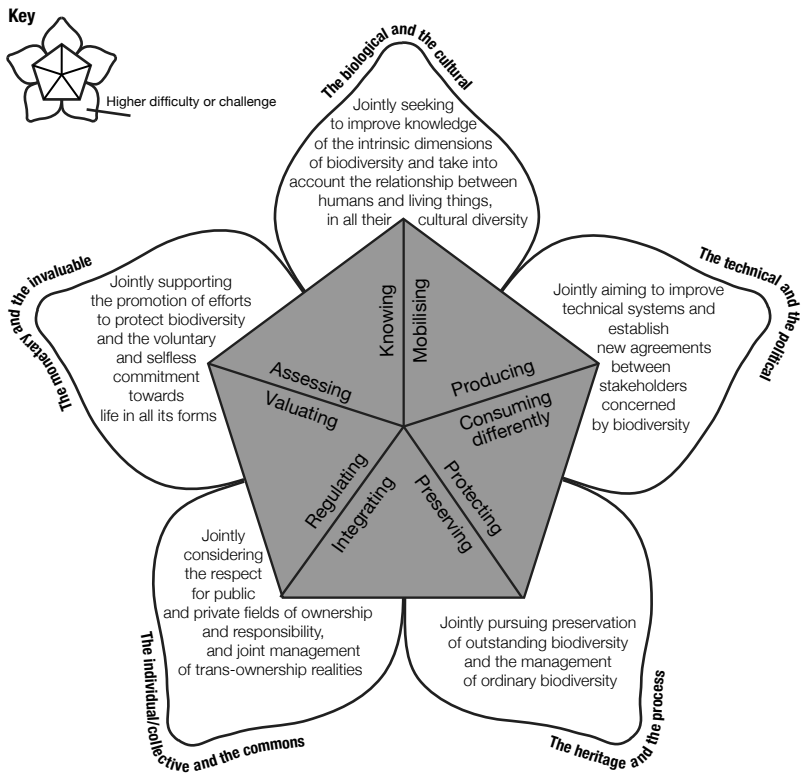

Figure 15. Monitoring biodiversity through subtle dialectics of action modes (adapted from Brédif, 2016)

ecosystem; an ecosystem that has been little affected by human activity or is natural; a more or less distant past reference regarding the wealth of flora and fauna in a given environment) and a current or foreseeable situation. Hence, it reveals trends and positive or negative developments, leading experts to produce a general assessment. However, this does not help identify the nature of the problem. How can we determine the nature of a problem involving humans if we deliberately leave them out? The prevailing diagnoses are, in fact, relatively poor regarding the nature of the biodiversity loss issue. They confuse the visible problem (the accelerated erosion of the diversity of living things) with the actual problem (the challenge of jointly managing five strategic directions with dual and ambivalent modes of action). In other words, the usual interpretations of the biodiversity crisis are mistaken in believing that a scientific diagnosis is equivalent to a strategic diagnosis (Brédif, 2021). Only by

reintegrating the human dimension, i.e. the relationship of humans to living things and the relationship among humans in their relationship to living things—as we have attempted to do in the second section of the book—is it possible to access the actual issue.

Finally, it appears that the usual diagnosis of biodiversity loss mainly focuses on the material and objective dimensions of the issue: biodiversity, as such, viewed as an intrinsic reality. It pays little attention to the relational, ethical and cultural dimensions of the subject, and the human factor is mainly envisaged from the perspective of exogenous anthropic pressure or impact. In fact, it almost wholly overlooks the crucial initiatives and sometimes heroic commitments mushrooming worldwide in favour of biodiversity. These commitments and actions are not new. The extraordinary biodiversity of certain agrarian landscapes (the damar agroforests of Sumatra, the Chagga gardens of Tanzania and the tropical tree gardens of Sri Lanka, the bocages of Western Europe, the agrarian mosaics of the Mediterranean), as well as the treaties on medicinal plants that have existed in India and China for close to 4,000 years or the reserves and other protected areas that have existed for a long time throughout the world are all examples of a long-standing concern and interest in the diversity of living things. By reintegrating these dimensions, a more comprehensive or integral reformulation of the problem of biodiversity erosion emerges. This means overcoming the traditional dualism in which biodiversity is viewed as a separate compartment, with human activity considered primarily in terms of its negative impacts. As long as this dualism persists, the only levers for action envisaged —the main approaches—will be exogenous to the problem and based on extrinsic human motivations. By reintegrating humans into the biodiversity issue—and not just as a factor of pressure or impact—we can envisage endogenous levers of action that focus on the positive relationship between humans and living things and their ability to restore or even increase the quality of living things. All these are endogenous levers for action that draw on the intrinsic motivations of stakeholders and societies. This paves the way to proposing new axiomatics, which should be taken as a cohesive and articulated whole.

– Humans are not necessarily and always a factor in the degradation of living things. Under certain conditions, they can restore it, care for it and even expand it. Therefore, there is no reason to reduce the human factor to an entropic force; human beings have negative entropic resources that they are able to activate.

– Ultimately, the biodiversity loss issue is more subtle than is currently portrayed by the 'dominant framework'. Failing a proper analysis and consideration of the variety of human relationships to the living realm, the diagnosis regarding biodiversity loss is necessarily incomplete, biased and falsely inclusive.
– The reformulation of the biodiversity loss issue in the form of five ambivalent challenges calls for a response likely to encourage a genuine dialectic of action methods. Therefore, the issue is not so much to find the solution or solutions to biodiversity loss as is conventionally understood—as if it were possible to find definitive and absolute remedies to the problem in question—but rather to design and initiate processes that are likely to maintain the desired dynamic balances in the long term.
– The ability of stakeholders to co-design and implement joint actions at all levels is a critical factor in the effective management of the planet's living realm. In this respect, the territorial level constitutes a strategic entity in terms of the management of living things.
– If biodiversity were envisaged primarily as a constraint, it would drive stakeholder commitment away. As much as possible, biodiversity should be viewed as a positive and motivating project, likely to foster a shared vision and a contract between stakeholders.

What is the path to change?

The Aichi Targets have not been reached. Based on this observation, some experts feel entitled to describe the past decade as a 'wasted decade for biodiversity'. The drafters of the opening statements at COP15 thus prepared to describe past commitments and work as a 'failure'. Furthermore, some people are quick to say that the same applies to biodiversity as to the climate: in both cases, collective inaction would be the rule.
Such allegations can undoubtedly be interpreted as a form of weariness and discouragement in the face of forces and dynamics that are at first glance unfavourable or even clearly incompatible with the 'ecological urgency' many people feel. How, indeed, is it possible not to surrender to a form of despair when faced with the modes of development of human societies, which are all too often unsustainable, when they are not, in practice, based on outright extractivism? How is it possible not to be concerned about the prevalence of conflict and growing inequality worldwide when preserving a habitable Earth would mean devoting ourselves to peace and fixing the most glaring injustices? How is it possible to have any faith in

political systems that demonstrate a daily obsession with short-sighted partisan rationales rather than managing cross-cutting, long-term environmental issues? Although perfectly understandable, such allegations and their underlying fundamental issues should not obscure the significant progress made in international negotiations on biodiversity.

First, we should note that they are profoundly unfair to the many researchers, experts, diplomats and officials who have worked tirelessly for years on the international process relating to the Convention on Biological Diversity. They dismiss the originality and merits of the Aichi Target platform, whose equivalent in the case of climate negotiations would be hard to find. Despite the imperfections and shortcomings of this platform, there is no denying that cumulative dynamics are at work. Gradually, a process of capitalising on experience and reflection is emerging, with significant results on several fronts: an increase in the number of protected areas on land and in the oceans, regular country reports on the progress made, closer links being sought between climate change negotiations and biodiversity negotiations, etc.

This type of hasty and sweeping assessment could be interpreted as a more or less deliberate attempt to up the ante, to alarm public opinion about the seriousness of the situation, and to increase the pressure on policymakers, whom nature conservationists inevitably lament are less involved in biodiversity issues than in climate change. Is this the best way to go about it? Is it sure that disqualifying the patient construction of multilateralism by declaring it incapable of achieving set goals will lead to a greater mobilisation of policymakers in this process?

Besides, by suggesting that the international process has failed, these criticisms suggest that we need a radical change in how we operate: a transformative change.[50] Prima facie, the drafters of the preparatory documents for COP15 showed that they had noted this when affirming that they had adopted a 'theory of change approach'. Except that it is difficult not to consider these words as a mere incantation. In terms of the theory of change approach, the official texts[51] merely:

– set out a vision: 'to live in harmony with nature by 2050';

50. To use a popular expression coined in the Leaders' Pledge for Nature of 26 September 2020.

51. https://www.cbd.int/doc/c/b0ad/2153/c2798e2ff41785f71e41cf1b/wg2020-02-03-fr.pdf

– to define, by 2030 and 2050, a series of five overarching targets very similar to those set for the 2010–2020 period;
– to draw a list of 'action-oriented targets for 2030', which are, in fact, sub-targets of a kind that do not clearly indicate how they are to be achieved.

A closer look shows that the change in the framework as it is defined relies to a large extent on exogenous changes: it is up to society as a whole to evolve positively in its relation to biodiversity. By stating that the Aichi Targets were not met, the UN process suggested that it was ready for self-criticism; in practice, it failed to question its own endogenous construction of the problem of biodiversity loss, i.e. its conceptual, thinking and action framework.

It will not surprise readers that we were not seeking to produce a new action plan. Not only because there are already many biodiversity action plans but, above all, because the critical issue lies elsewhere. Indeed, as many experts involved in international negotiations sense, a framework change is advisable. Yet it is crucial not to pick the wrong target: the conceptual framework for international negotiations on biological diversity is what must be freshly thought through. To this end, there is no need to repudiate what international negotiations have produced or give in to the easy defeatism around climate negotiations. The biodiversity-related international process is very different from the climate change process: biodiversity stakeholders have nothing to gain by forcing the analogy between the two processes to reach the same conclusion of collective inaction. Instead, when it comes to biological diversity, it is essential to recognise how far we have come, to celebrate the progress made, the consistency of the documents produced and the promising structure of the target platforms. It is also important to stress the extent to which international negotiations and the resulting global strategic framework are formative since they largely determine the structure, content and tone of regional, national and local biodiversity strategies. Such a prerequisite helps to tackle the following question: why has the momentum of the international process failed to deliver the expected results? Is it simply because decision-makers have lacked political will—in keeping with the usual argument about the disconnect between rhetoric and practical action? Or is it instead because the conception of the global strategy was not as comprehensive as we thought?

Having demonstrated that significant dimensions of the biodiversity loss issue have been left out, we propose reintegrating these dimensions to

formulate the problem more appropriately to the subject under consideration. This will help devise a strategy better adapted to the dynamics of biodiversity. To this end, we propose five major levers for change, each with specific potential and synergistic effects.

For a more comprehensive formulation of the problem

As it stands, the formulation of the biodiversity loss issue does not provide sufficient ground for establishing a more efficient strategy.

Under these conditions, calling for urgent action makes little sense. Until there is a better understanding of the nature of the biodiversity loss issue, it is unrealistic to expect that greater political will or significantly increased resources alone will guarantee better results. A problem well-defined is a problem half-solved, as the saying goes. Consequently, we should stop pretending the ball is only in the politicians' court; it is also, and primarily, in the scientists, experts and diplomats' court. The international process is doomed to stagnation and failure if it does not achieve a more comprehensive and fairer formulation of the problem that is its raison d'être.

To this end, three sets of changes seem necessary. Firstly, the composition of the scientific and technical process responsible for framing the problem should be broadened, allowing room for other disciplines and forms of expertise. Relying primarily on the life sciences and conservation ecology to diagnose the situation necessarily leads to confusing the 'state of biodiversity' and the 'issue of biodiversity loss'. Looking at the current composition of the IPBES, it is evident that the declarations of intent on this subject are far from being followed up in practice.

Secondly, the strategy currently being pursued denies itself considerable resources when it sidelines the positive relationships, both actual and potential, between humans and biodiversity. No significant improvement in the effectiveness of strategies to fight biodiversity loss can be achieved as long as humans are seen primarily as exogenous and unfavourable impact factors. Restoring the relationships of humans to living things, in all their complexity and diversity, is the key to rebuilding strategic thinking on biodiversity and opening up new horizons for action.

Lastly, the UN framework is designed by and for States. It is bound to be restrictive and inadequate to grasp all the dimensions of the issue of biodiversity loss. While it is a legitimate and relevant framework to treat part of the issue, expecting too much of it is pointless. The UN framework

can only establish a fraction of the global strategy in favour of biodiversity, albeit an important one, but necessarily limited. The time and space involved in devising a global strategy should not, therefore, be confused with the time and space involved in inter-state negotiations. The UN framework does not have a monopoly on the strategic conception of biodiversity; other forums involving other players must contribute in their own way, to their own extent and alongside the UN process, to fuel global biodiversity-friendly strategies. Acknowledging the merits and limitations of each of these processes might avoid many deceptions and foster critical synergies and complementarities.

Revealing the extent of human engagements

'Nobody cares about biodiversity … except for a few people'[52]. This outcry of indignation from a Minister for Ecological Transition who comes from the civil society should be taken seriously. It encapsulates the feelings of many ecologists and naturalists who are still convinced that the decline of living things inspires nothing but fatalism and, even more so, indifference in most of their contemporaries. As a result, they often come to terms, after so many others, with the fact that, under these conditions, the carrot and the stick, financial incentives and regulatory constraints are effectively the only means of influencing behaviours.

Rather than transposing to biodiversity the defeatist and nihilist attitudes that sometimes affect the issue of climate change on the grounds that 'humans couldn't care less', several essential considerations should be highlighted.

Unlike climate change, the 'return on investment' with biodiversity is much quicker, direct and tangible. Initiatives to reconstitute the living fabric, at least on a local scale, are quick to bear fruit: everyone can easily verify this and find encouragement to continue their efforts.

The scale of the biodiversity crisis has led many commentators and experts to focus exclusively on declarations, commitments and far-reaching government measures—and only if such measures translate into better protection for nature against 'human expansion'. As a result, local

52. Statement made on 21 March 2018 at the French National Assembly by the Minister for Ecological Transition and Solidarity during questions to the government, a few weeks before the presentation of the Biodiversity Plan designed to strengthen France's action to preserve biodiversity.

biodiversity initiatives, no matter how numerous and relevant, receive little attention.

In his *Sand County Almanack*, Aldo Leopold (1949) already emphasised how the management skills of European forest owners were a boon to the careful management of habitats and species. More recently, Edward O. Wilson considered that human beings were prone to biophilia. Although supported by some of the leading figures in ecology, these fundamental observations are not typically included in the general rhetoric on the crisis of the living realm.

In considering only global measures and focusing solely on public policies, biodiversity specialists place themselves in a kind of self-fulfilling prophecy: they no longer see the rich and dense relationship that many stakeholders have to different forms and expressions of living things; they disqualify the subtle adjustments, silent transformations and courageous initiatives that many people make in their daily actions and longer-term projects (Box 5); they appear insensitive to the difficulties and obstacles that so many grassroots operators face in their quest to take better care of living things. The result is a kind of cognitive dissonance or reality schism regarding the actual situation: for many experts and activists, 'our house is on fire, and we look away', while many players in the field burn with the desire to act, but it is the institutions that look away.

Box 5. A group of Indian women reinvent agriculture

Anne Pinto-Rodrigues, a journalist specialising in social and environmental issues, analysed the example of a small group of women in India who joined forces to reinvent a long-forgotten form of agriculture adapted to today's climate: millet.

Growing rice and wheat was strongly encouraged during the Green Revolution of the 1960s, and farmers received incentives to use hybrid seeds, chemical fertilisers and pesticides. With almost 60% of the country's farmland dedicated to rain-fed (non-irrigated) agriculture, rice and wheat growers rely on weather conditions that are becoming less conducive to farming with climate change.

With the support of an Indian non-profit organisation called SABALA, which aims to improve food security, women have taken action because they and their children suffer from anaemia, stunted growth and other disorders caused by inadequate and unbalanced nutrition. Women in the Vizianagaram district have started growing different varieties of millets, interspersed with vegetables, legumes and oilseeds.

The investment needed to start growing millets is low, but they provide every possible kind of security. In addition to food, nutritional and health security, these crops also ensure financial, fodder, seed, soil, environment, and cultural security. Preserving the soil, reducing chemical inputs, maintaining a diversity of crops are just some of the actions that foster biodiversity.

Building on their success, almost 300 women farmers have set up a cooperative called Arogya (a Sanskrit word meaning 'global well-being'). This organisation now includes close to 1,000 women farmers from the Vizianagaram district. Arogya

reinvests profits in training its members to produce high-value-added millet-based products.
'Millet farming is a way for them to grow food crops of their choice for themselves and their families It enhances their livelihood options, instils confidence in them, and earns them the respect of their family and community.', Shiney Varghese points out, having served on the High-Level Panel of Experts of the UN Committee on Food Security from 2017 to 2019. She adds, 'Scaling up agroecological efforts through climate resilient approaches like millet farming will go a long way in achieving local food and water security while ending hunger and malnutrition.'

Source: https://systemschangealliance.org/indian-women-turn-to-ancient-grains-to-feed-their-families-and-their-futures/

It is doubtful that the global biodiversity situation will improve significantly as long as so little attention is paid to grassroots players. To put an end to this formidable misunderstanding, it would be appropriate:
– To carry out an equivalent study to the Millennium Ecosystem Assessment on the relationships of humans to living organisms. A 'Millennium Caring Assessment' would help spotlight the wealth and diversity of humans' relations to living things and the remarkable value of the efforts and care some stakeholders or stakeholders devote to biodiversity.
– Such an undertaking calls for accumulating a broad range of case studies at all scales and in the most varied socio-political and natural contexts possible. Furthermore, caution should be exercised when considering how to care for living non-human organisms, as this activity can take unexpected, indirect and sometimes counter-intuitive forms.
– As well as identifying and describing these approaches to caring for living things, the aim would be to study the difficulties and obstacles encountered, how to overcome them and, more generally, the conditions for actively addressing the issue in different contexts.
Such an approach would bring about a profound change in the way we look at the relations between humans and biodiversity. The official diagnosis on biodiversity would undoubtedly need to change. It could no longer be based on a dual interpretation that pits fragile, threatened nature against inconsistent, predatory humans.

Thinking in terms of processes and dynamic equilibriums

Traditionally said, where there is a problem, there is a solution. The moment biodiversity loss, like global warming, is viewed as a global problem, minds start seeking a global solution or, more simply, solutions. Admittedly, in certain contexts, specific measures and systems can be quite conclusive (Box 6).

Box 6. When the problem-solution approach becomes possible and conclusive

In some cases, it is indeed possible to view biodiversity loss as a simple problem that one or more solutions can solve. Unfortunately, these cases are all the more remarkable as they are rare. Here are a few examples.

The building of Port 2000, Le Havre's new container terminal, between 2001 and 2005 caused the disappearance of former dredging sites used as resting places by many bird species in the estuary. As the disturbance caused by human activities was incompatible with accommodating the avifauna, the solution was to set up an island in the Seine estuary that was off-limits to visitors (apart from occasional visits by managers), thereby recreating a habitat favourable to birdlife. By 2005, no fewer than 69 bird species had been identified on the new site. Given a problem with an isolable cause, proposing an appropriate and functional solution was possible.

'Lake Annecy in Haute-Savoie was renowned among fishermen for its noble fish such as Arctic char. In the 1950s, char became rarer, and water clarity, which was around ten metres at the beginning of the century, had been halved. The cause was quickly identified: untreated sewage discharge heavily laden with nutrients. As a result, the lake was in the process of eutrophication, with apparent symptoms: increased turbidity linked to the development of phytoplankton as a result of nutrient inputs. The only solution possible was to treat the wastewater to reduce inputs. In 1957, the local authorities decided to build a sewer system that would run around the lake and lead to a wastewater treatment plant. The construction work lasted until 1972. Since then, the lake's water quality has slowly returned to good levels. In 1993, water clarity was at 12 metres, the same as measured at the beginning of the century' (Lévêque, 2008).

Bluefin tuna has been fished around the Mediterranean for 7,000 years. In the early 2000s, scientific studies showed that bluefin tuna populations were collapsing, both in the Mediterranean and in the Atlantic: the boom in industrial fishing with tuna seiners, coupled with the explosion in global consumption of sushi and sashimi, led to fear that the species was disappearing. In 2008, the stock of reproductive bluefin tuna in the Mediterranean and Atlantic fell to 150,000 tonnes. Various initiatives (from NGOs such as Sea Shepherd to the Principality of Monaco) alerted public opinion to the planned disaster and put pressure on governments. In 2006, the International Commission for the Conservation of Atlantic Tunas (ICCAT) introduced a dramatic reduction in fishing quotas (12,000 tonnes authorised in 2011), coupled with increased controls on boats and markets to fight illegal fishing, a genuine scourge for bluefin tuna. In 2013, spawning stocks rose to 585,000 tonnes; in 2020, the ICCAT reviewed fishing quotas upwards.

However, there are substantial obstacles to the widespread adoption of this approach.

Situations where the application of 'dedicated solutions' yields direct results relatively easily are usually exceptional or borderline cases: far from being the rule, these are rare events that require favourable conditions to succeed. More often than not, biodiversity issues are inextricably linked to unavoidable socio-economic, cultural and political contexts; as a result, the biodiversity issue cannot be separated from its context, and dedicated solutions often prove insufficient, if not impotent.

As demonstrated in the second section of the book, the big solutions toolbox faces several limitations, according to various specialists, including ecologists. The criticisms and the paradoxical effects identified suggest that biodiversity-related issues call less for solutions than for processes to dynamically manage delicate balances between apparently contradictory considerations. Thinking in terms of solutions implies that the problem could be solved once and for all and that a remedy could be found to eradicate the problem for good. Such an approach belongs in the realm of mechanics and inert things, and it is ill-suited to the challenges posed by living things, which are marked by a high degree of uncertainty and characterised by unpredictable and changing dynamics.

Fundamentally, we believe we have demonstrated that protecting nature cannot be the solution to the issue of biodiversity loss, even if the dominant rhetoric regularly tends to claim the contrary. Thus, the response —and not the solution!—to the biodiversity loss is to maintain, activate and adjust, over time, a set of processes to ensure that the quality of living things is maintained, supported and even enhanced (Box 7). In other words, the very wording of the purpose of biodiversity strategies is reductive and should be wholly reformulated.

The change in approach may seem far-reaching. But in truth, nobody no longer believes in ready-made solutions except in special cases; even more, everyone is more or less aware that such solutions often have the paradoxical effect of establishing a form of fixism that runs counter to the dynamics of living things. In the end, the disconnect is not so much between the rhetoric of policymakers and the actions that follow; it stems first and foremost from the fact that measures conventionally envisaged fail to accommodate the complexity of interactions with humans and the dynamics of processes linked to living organisms. To foster such a synchronisation, we propose:

– Learning to reconsider biodiversity problem management by setting up a set of case studies to shift from a problem/solution approach to a problem/process approach to foster active management. In other words, more attention should be paid to the conditions and methods likely to encourage people to take active and positive responsibility for living things. Typically, rushing to use ready-made solutions precludes in-depth consideration of the needed resources. However, if strategy corresponds to 'the art of achieving one's goals', then the question 'how' is central and by no means self-evident.

– In some cases, accepting a short-term loss in intrinsic quality strengthens the stakeholders' capacity to work together to build sustainable responses for a better-shared responsibility for the quality of biodiversity. If the fight against biodiversity loss becomes an endless source of constraints, threats and mistrust, there is no reason to expect the situation will improve. Conversely, striving to ensure that it becomes a source of motivation, projects and meaning for stakeholders in a territory can dramatically change a situation.

Box 7. Restoring the Great Plains? Challenge met for Dan O'Brien

Dan O'Brien, a breeder and falconer who teaches ecology and literature, has set himself the challenge of restoring life to the Great Plains of North America. For nearly twenty years, from 1972 to 1990, O'Brien successfully strove to restore peregrine falcons to the Rocky Mountains. At the same time, he tried to develop another form of livestock farming to restore the prairie environment on the small ranch he had purchased, but this time, he only met with disappointment and bitter failure.
Yet he had no choice: his visceral attachment since childhood to the immense plains at the foot of the Black Hills in South Dakota was stronger than anything. After travelling the length and breadth of the Great Plains, he became aware of a deadly mechanism of concentration and reciprocal exclusion: on the one hand, vast reserves where the last Indians were slowly dying; on the other, a form of intensive agriculture and livestock farming that was exhausting the soil, contaminating the water and demeaning even the bison being raised as mere cattle. As for the government and nature conservation NGOs' action programmes, he had witnessed enough of their limitations and failings to expect any remedial action.
In his book *Wild Idea* (2015), the true story of his adventure, O'Brien showed how, through trial and error, he successfully triggered a restoration process in the Great Plains. His ultimate goal was not 'to protect the Great Plains' but to take care of it as a whole, including all the living things—human and non-human—it shelters. It is fascinating to see how, little by little, O'Brien's wild project managed to recruit and involve a growing number of people who each brought specific skills, new relationships and perspectives, thereby helping his project cross decisive thresholds. Dan O'Brien's venture turned out to be a networking and contractual operator between highly diverse people and beings functioning on different scales, who found in it a way of obtaining the qualities they were seeking: healthy, tasty meat, animal welfare, warm and friendly relationships, restoration of the Great Plains ecosystem, meaning, the feeling of belonging to a project community, etc.
O'Brien's account shows that human beings are not just a cause of degradation and wear and tear or contributors to the acceleration of entropy. With the right approach, they can contribute to regrading and even enhancing the qualities of nature and living things.

For a detailed presentation of this case, see 'De la limitation des usages à la prise en charge : l'écologie intégrale selon Dan O'Brien' (Brédif, 2018).

Supporting a network of local initiatives on a global scale

At COP21, the local approach was recognised as an essential lever in the fight against global warming. Nothing of the sort, though, for biodiversity: the tools and measures proposed largely ignored the local dimension and implied that the issue of biodiversity loss was essentially governed by universal solutions, with no actual reference to any context whatsoever. Is this because biodiversity is seen primarily as something threatened by humans? Therefore, the range of solutions is dominated by an approach to preservation and protection that takes a secondary view of the context and of the human context in particular? This is a paradoxical situation, to say the least, insofar as it stands in stark contrast to observations that everyone can readily confirm.

The diversity of living things varies from place to place. Moreover, it is rooted in widely differing human, social-economic, political and cultural contexts. As a result, the relations of human groups to the different forms of living organisms vary considerably from one place to the next, just as the capacities or room for manoeuvre of local societies regarding biodiversity differ significantly.

Quite often, the territorial space is already a matrix for local stakeholders to manage and care for different living organisms. The depth of the relations they have developed with their natural environment has led these stakeholders to acknowledge its importance in developing the area where they live, as well as for their identity. It is easy to spot the existence of specific biodiversity management plans and the expression of a territorial project that places biodiversity as an important or even essential component of the territory's dynamics. In addition, the idea of a positive biodiversity territory, which is slowly gaining ground, clearly shows that territorial space is a highly relevant lever for managing and caring for biodiversity.

Indeed, territorial space is absolutely critical, for two reasons. Situated between the individual scale, which is interesting but often too specific, and the global scale (national, continental, even worldwide), it is a space of relative proximity, neither too far nor too close. A 'meso' space, not limited to administrative or institutional territories, to which a group of stakeholders can relate; a space that makes sense through the density of interdependencies that connect a group of people; a space where the effects of global sectoral policies, as well as those of local actions and practices, can be observed almost in real-time; a space in which the question of the possible concordance of these policies and practices can be

posed and addressed. In short, it is a space where the issue of consistency, coherence and integration can be addressed, whereas it is much more challenging to tackle on a larger scale. Thus, the territory is potentially a *unitas multiplex*, an entity capable of fostering coherence and cohesion for a coordinated, positive and integrated approach to caring for the quality of living things.

International and national policies and strategies on biodiversity have no reason to fear the rise of territorial dynamics to address the issue of biodiversity. On the contrary. In the current approach to biodiversity, the hopes placed in a global strategy are proving excessive and unrealistic. They imply that the solution must necessarily come from the top down, with the 'local-territorial' dimension mostly seen as a relay or an application space for a strategy devised in high places. Such an approach is detrimental both on the global and the local-territorial scale. It puts excessive pressure on States, which have only limited resources to act; as for the territorial level, wrongly confused with the local level, it is not acknowledged for the singularity and importance of its role in differentiated and integrated biodiversity-positive action.

To restore the territorial approach to its rightful place and ensure it is articulated with global biodiversity strategies and policies, we propose:

– To compile a series of case studies to illustrate the reality and importance of territorial issues with regard to biodiversity. There are many existing monographs on the subject, produced notably by teams of geographers or anthropologists. If the UN process were to foster the development of such a body of work and support its findings, it would help break out of the prevailing top-down approach in which it is trapped.

– In addition to existing research, a network of territory workshops could be developed. An international call for applications would enable the selection of several sites for a pluralist group of stakeholders to propose, over three to five years, a global reconsideration of the relationship between a territory and the people who inhabit it and the various manifestations of living organisms, to restore biodiversity or significantly influence the processes that are driving its decline. The international community would actively support such territorial experiments without imposing an overly precise framework for action. Assessments, exchanges and comparing notes between these experimental sites would help draw general conclusions: obstacles, conditions and the means to overcome them, successful experiments, promising modes of dialogue and governance between stakeholders, and undergoing change processes.

Once the importance of territorial leverage in actively addressing the issue of biodiversity quality has been established, the matter of establishing connections can be addressed: connections between territories, both near and far, whose cooperation could foster a greater positive aspect for certain aspects of biodiversity; between territorial projects and initiatives and global measures and policies, which could benefit from better exchanges to encourage positive synergies by ensuring that the efforts and actions envisaged are complementary.

Revitalising the global strategy through all these elements

The COP15 will not fundamentally alter the state of affairs. Although it confirms and builds on certain advances, it does not augur a genuine change in thinking and action. Mostly, biodiversity loss is still considered from a top-down perspective. Apart from government representatives, ecology experts and large environmental NGOs, few players are associated with the technical and strategic expertise supporting international negotiations: the search for solutions still monopolises the attention. In addition, there are legitimate doubts over the explanation for the partial achievement of the Aichi Targets, namely that the targets were insufficiently precise—as was the resulting recommendation, 'We need more precise objectives for the coming decade'. As is often the case in this type of international and intergovernmental process, using the *objective* evaluation tool to assess progress serves to hide the lack of reflection on the necessary and sufficient methods for achieving the *targets*! With this in mind, three comments should be highlighted on designing strategies addressing complex issues such as biodiversity loss.

When it comes to major environmental issues, the UN framework tends to confuse strategy with planning. It continues to operate in a declarative mode, striving to define principles, rules and targets as if reality would comply. Conceived of in terms of control and management, international conventions and implementation plans are rapidly overwhelmed by the proliferation of causes, the explosion of interactions and the systemic effects on different scales in space and time. The protagonists in these processes, chief among them the representatives of the States, lose their credibility by perpetuating this confusion. Genuine strategic thinking on an issue as complex as biodiversity loss cannot be confined to the top-down negotiation of grandiloquent commitments and precise targets by 2030 or 2050 if these are not supported by in-depth reflection on how to

have a chance to achieve them in a highly interactive, multi-stakeholder and evolving context.

While some aspects of biodiversity loss can be solved by applying specific economic, legal, administrative or technical solutions, many aspects call for a completely different approach. Many biodiversity challenges cannot be isolated from their economic, political and human context; better still, they require an active, informed and motivated contribution on behalf of many stakeholders to be adequately treated and addressed. Therefore, reintegrating the human factor into strategy is essential; devising strategic directions that think more in terms of processes than specific solutions is a necessary consequence and adding to pressure regulation a lever for action is no less essential.

The United Nations framework was designed by and for States. Its purpose is not to bring together all the stakeholders in biodiversity. Therefore, one should not expect that international negotiations will result in a global strategy, in the sense that this would be the outcome of addressing the plurality of players concerned by the challenges of biodiversity. At best, it can be a global strategy of States, designed and driven chiefly by States. It cannot be a global strategy that all human beings, in their diversity, have devised and are working together to implement. Hence, what remains to be done is to prefigure and set up institutions that encourage cooperation between public and private stakeholders so that the latter can co-construct actions and strategies to complement the range of tools governments provide.

The issue of biodiversity loss does require one or several strategies. It cannot be reduced to an evil we would attempt to eradicate by applying dedicated solutions. As we believe we have demonstrated, the challenge is not limited to preserving and protecting nature from human hubris; more fundamentally, it is a matter of supporting and activating processes to take care of the quality of living things at all scales and in all aspects that require it. With this in mind, we suggest:

– Not to give in to the current temptation to despair of multilateral action by States and recommend reliance on bottom-up solutions, most often defined as actions by individuals or small groups of people. The challenges surrounding living things require commitment from everyone at every level of reflection and action: under no circumstances is it a question of pitting one country against another or governments against citizen movements. Instead, it is crucial to recognise that legitimacies and responsibilities are different, which will avoid confusion and oversimplification.

States are legitimate to decide on large-scale issues and define rules and collective actions. The mistake would be to believe or to allow others to believe that they alone can devise the global strategy that will solve, once and for all, the problem of biodiversity loss. Similarly, local and territorial stakeholders have every right to design strategies to maintain or restore the quality of living things in areas of primary interest to them. As we highlighted previously, it would be a good idea to encourage them to do so and to acknowledge the value and the actual and potential scope of such initiatives. Where biodiversity is concerned, as with other major global issues, the singular should be abandoned in favour of the plural: multiple strategies are called for and should be encouraged. Focusing attention solely on the strategy developed at the COPs is tantamount to disqualifying the actions of 'small' players and giving pride of place, time and again, solely to the 'big' players. This political and mimetic reflex must be overcome.

– Acknowledging that the legitimacy and merits of this two-pronged top-down and bottom-up approach will help address biodiversity loss in new terms. Shifting the focus away from international processes will make it easier to identify the merits and limitations of each approach and, above all, to consider how they can work in synergy. From that point onwards, the merits of a third place will become more apparent: a place for meeting, exchanging and negotiating to help the players from both dynamics to pool their expertise and envision the conditions for positive coordination of their respective capacities for action.

– Taking the time to perform a retrospective analysis of the responses to biodiversity loss: the 'more of the same' approach has sufficiently proved its inability to curb biodiversity loss. To this end, it is vital to clarify the relations between science, expertise and strategy, as there is often much confusion in this field regarding public action. Science is there to say what is, not what needs to be done. And while it is undoubtedly advisable, as Edward O. Wilson (2002) recommended, for the life and earth sciences and the human and social sciences to work closely together in a quest for greater cooperation and synthesis, which he calls 'consilience', this is not likely to change the vocation and role of science. Taking action calls for another approach. It may be limited to expertise and political will when the issue is sufficiently known and understood and when there is no controversy about the goal to be achieved. However, if the problem is difficult to identify and isolate from a dense context of factors and issues, if it is a matter of agreeing on a goal or a set of goals that are not obvious;

if it is necessary to seek constructive involvement of a plurality of people and operators whose primary objectives are not biodiversity; if, in short, it is a question of finding the conditions and the means likely to foster a positive and enlightened synergy of a multitude of potential contributors to a common design liable to incorporate biodiversity objectives, this is where strategy comes in. Easy, simple and stable action falls within the realm of planning. Complex, highly adaptative and anticipatory action requires strategy.

OVERVIEW AND OUTLOOK

'In fact, balance requires constant effort and courage. The society that will have this courage is the true society of the future.'
Albert Camus, 1955

Biodiversity loss is a crisis like no other. The prospect of baobabs, rhinoceroses, butterflies, rainforests and coral reefs disappearing from the face of the Earth tomorrow shakes us to our core. Worry and despondency are soon followed by anguish as scientists and experts relentlessly proclaim the imminence of disaster, expressing their distress at what they and others call 'political inaction'. How can we hope to perpetuate the will to live and give life in a world that fails to maintain such sources of wonder and ineffable joy?

Doing away with the easy way out

In its now traditional expression, the diagnosis is damning. All of humanity is guilty and answerable. Both 'biodiversity' and 'the climate' inevitably bear the consequences of its arrogance and extremes. The great 'collapse' is looming. Notice how this clash of totalities monopolises our attention. These sweeping globalisations and the relations that bind them enjoy the advantage of simplicity, but at a price: it blinds us to essential data.

Has humankind caused destruction? Without a doubt! But not all humans, not always and not everywhere. 'The human species' is not the enemy of biodiversity: the relationships between humans and non-human life forms are much richer, denser, diversified and creative than a certain vulgate would have us believe. Yes, widespread human expansion causes damage. But the contraction or retreat of the realm of humans for the sake of rewilding the world is not necessarily the only or the best response.

Nobody, or almost nobody, is interested in biodiversity loss. Such a statement overlooks the plethora of initiatives and projects, both individual

and collective, aimed directly or indirectly at restoring, if not enhancing, biodiversity. Failing to acknowledge these efforts and commitments, to support and celebrate them, is tantamount to disparaging them a priori: 'See how puny and derisory they are compared with the immensity of the challenge!' This is an old reflex of the mighty, who only pay attention to what seems commensurable with their ambitions. Such denial of the changes at work is profoundly unfair to those who work tirelessly to protect biodiversity; it fosters a climate of despair whose deepest motivations we would be curious to know.

Non-humans are the first victims of anthropogenic excesses. This rash statement ignores that many human beings are suffering severely from the fraying of the fabric of life. Living in an environment of concrete and asphalt, eating mainly artificial products, and losing any immediate connection with otherness and the splendours of nature is a far cry from any kind of progress in the human condition. One should never lose sight of the fact that all living things, including humans, are being mistreated. Quantitative data on biodiversity loss must not hide the reality of degradation in the quality of life that many humans now face. 'Ill-being' is a lasting obstacle to a redoubled effort in favour of biodiversity.

These few observations could almost serve as an answer to the question posed in the introduction to the book: evidently, the diagnosis on which global biodiversity strategies are based is incomplete. While it is objective in that it looks at the state of biodiversity as an object, it cannot be strategic because it confines humans to an exogenous role, reducing their status to that of an impact factor. Failing to take greater account of the relations of humans to biodiversity and to the subjective, organisational, institutional and projective dimensions of the problem, hoping to find real levers for change is completely illusory.

Reconnecting with the complexity of reality

Let us start again on a broader basis without making a clean break from the main elements of the official diagnosis. Let us retain from this diagnosis that biodiversity fulfils crucial roles and functions for human well-being and that, in consequence, the loss of its various components is detrimental in many respects, and that five fundamental factors (rather than genuine causes) corresponding to the letters of the acronym HIPPO-C (habitat fragmentation, invasive species, pollutions, overexploitation, climate change) are generally involved in the degradation of the situation.

So, this is a first assessment of the situation and it is certainly cause for concern.

However, if the saying—a problem well-defined is a problem half-solved—is to be believed, one must admit that we are still far from the mark. Admittedly, the official diagnosis includes elements that help to characterise the issue of biodiversity loss: it does say why and, to a certain extent, for whom it is a problem and what the main aggravating factors are. But the nature of the problem, i.e. the underlying structure that might explain its persistence and even its intensification, remains hidden; it is manifestly difficult to access—unless we accept explanations that are as superficial as they are facile.

Yet, how can we access this structure which escapes causal logic? By proceeding indirectly, as astrophysicists do when they use deformations in space-time or gamma-ray emissions to detect the presence of celestial bodies. Or, similarly to biologists who scrutinise the reactions of a new organism to external stimuli to identify its specific properties and aptitudes.

Now, we have just such information. For over a quarter century, biodiversity experts and the international bodies tasked with this issue have been subjecting the problem to a series of measures, action plans, public policies and strategies. Instead of considering that these schemes are intrinsically good and that they have not delivered on promises simply due to a lack of political commitment, we propose to reverse the perspective. These schemes, their successes and failures, are an indirect way to get to the roots of biodiversity loss. Observation, analysis and comparison of their effects provide a general overview of the nature of the problem in question. Three observations emerge from this line of reasoning.

First observation: the anticipated results are not forthcoming. The implementation of the Aichi Targets is regarded as a virtual failure by international negotiators and experts. The prognosis for the future of biodiversity on Earth is bleaker than ever. And yet, COP after COP, principles and schemes hardly vary. As a new plan for the next ten years is being drafted, Member States and international experts advising them are preparing to pursue a similar course of action to that which has prevailed until now. No significant change in the framework of strategic reflection is happening. More of the same prevails as if a hypothetical increase in political will and financial resources were enough to change things. As if it were enough for the world's leaders to commit, once again, to ambitious goals for those goals to become a reality.

Second observation: international declarations call for general mobilisation, but in practice, implementing these strategies leads to a generalised feeling of being relieved of all responsibility. After all, how can we fail to see that the strong protection of species and areas here signals that it is possible, not as bad and almost acceptable, to degrade them elsewhere? If it is enough to pay to destroy ecosystems, why should we not? Does the widespread development of short distribution channels mean the end of cash exports for some developing countries and, therefore, even higher economic and social fragility? If scientists and experts know what to do and decisive action is mainly in the hands of governments, then what point is there for ordinary citizens to get involved? Applying the dominant methods of action traditionally adopted to fight biodiversity loss generates a series of unexpected, paradoxical and perverse collateral effects. Sooner or later, one person's solution becomes another person's problem!

Third observation: the paradigm underpinning biodiversity strategies continues to oppose humans as culprits and nature as the victim. Nature must be protected and kept at a distance from predatory humans. Yet, many humans aspire to be closer to nature and to share its benefits. Similarly, although many experts call for everyone to participate, prevailing strategies focus on the impersonal tools of law, economic mechanisms, knowledge and research to curb biodiversity loss. In so doing, they pit the global, which has to think and decide, against the local, which must be content with applying and executing. Mistrust of ordinary stakeholders prevails: 'How can they resist the lure of profit, the stratagems of lobbies, market forces and the seductive calls of consumer society?' Biodiversity thus becomes a problem in its own right, kept separate from the many social, economic, health and geopolitical challenges of everyday human life. Ultimately and for all practical purposes, the prevailing strategic direction separates and divides more than it connects; it erects more walls than it builds bridges and links. The structure of the action this strategy promotes compartmentalises, fixes and divides where, on the contrary, the dynamics of the living realm imply fluidity, interactions, and the search for synergies and bridges.

Monitoring subtle equilibriums

Faced with high-profile crises, governments and the qualified experts on whom they rely have, for some years now, been making unrestrained use of the strategy concept. Etymology leaves no room for doubt: a strategist is

the leader of an army, a general or a war chief. Confronted with deforestation in the tropics, climate change, biodiversity loss or the eruption of a malignant virus, the recurrent use of the notion of strategy suggests that we are, in fact, at war. And when it comes to biodiversity crises, which we are constantly told are instigated primarily by humans, it is a no-brainer: we are the enemy! So here we are, at war with ourselves. At last, matters stand clear.

However, not every human action has to do with strategy. The use of the term is tantamount to acknowledging that a degree of adversity stands in the way of achieving ends. Simple, repetitive actions that are under control or guaranteed to achieve the intended goal do not fall within the remit of strategy; they are simply a matter of administration, technique or planning. In contrast, the strategic approach is justified by a sufficiently complex, labile and uncertain context that makes achieving the objective challenging. As a result, strategic thinkers from the earliest Chinese treatises on the matter have recommended: firstly, to meticulously examine the terrain, identifying its precise characteristics, actual and potential pitfalls, sources of uncertainty and fixed elements, not to mention the promises of gains; secondly, to match the ends to the means and vice versa, in other words, to think jointly about the question of ends and mean, while avoiding the unfortunate mistake of believing that the means necessarily follow the ends, and are merely a trivial and quasi-mechanical variation of the latter; thirdly, to detect critical levers for action, likely to tip the outcome of operations in favour of the strategist and their camp. What can we achieve by applying these three keys of strategic thinking to biodiversity?

The meticulous analysis of the situation in the book's first two sections showed that the official diagnosis has underestimated or even ignored several dimensions and aspects. These neglected areas or blind spots, provided they are restored to their rightful place, open up a profoundly renewed strategic landscape. Affirming the importance of ordinary biodiversity alongside remarkable biodiversity helps shift from a fixist interpretation to a view of biodiversity as a 'process', thereby recognising the creative role humans play. Estimating the monetary value of ecosystem services for specific, one-off needs should not detract from the fact that life is priceless. Accepting that objective, rational knowledge is not the only way of engaging with non-human living things does not undermine the relevance of the scientific approach. Still, it does suggest other ways of mobilising stakeholders than simply by raising awareness. Granting not only governments

but also many other players and levels of intervention a significant role in taking active responsibility for biodiversity will help to break out of the dual rationale of the individual versus the collective and to explore the promising and complementary field of the commons. Understanding that changes in production and consumption patterns depend as much on technical innovation as on new partnerships between operators restores politics and contracts to a prominent place in regaining control of technical and economic systems. Ultimately, the problem of biodiversity loss can be viewed as a 'base five' problem: five primary functions interacting with five major components of human well-being; a state and a general dynamic likely to be affected by five major factors; a response or riposte to contemplate through five primary strategic directions, each based on ambivalent arrangements: a system of countermeasures and checks and balances which, depending on the situation, compensates for or corrects the excesses and potential excesses of each measure.

Faced with biodiversity loss, the international community has committed to providing greater protection for nature. Biodiversity then becomes an end in itself; the resulting action plan (the means) essentially aims to build a bastion to limit or delay anthropogenic disturbances, forcing and other nuisances. The man/nature dualism thus results in the subordination of means to ends: there has been no joint reflection on ends and means. There is only one way out of this trap: to break away from dualism. Both the means and the ends must involve humans. Everything changes once the human factor is no longer considered merely as an unfortunate extraneous factor; once the different ways in which humans interact with non-humans, their varied sensitivities and motivations, their current or potential needs and projects, their ways of living and forming society, their forms of political organisation and their capacities for individual, collective and joint action, are reintegrated into the formulation of the issue of biodiversity issue and the responses that might be found. Hence, a new aim emerges: to strive to better care for the quality of living things, humans included, of course. A new set of means also emerges: implementing and managing processes capable of fostering dynamic equilibriums between distinct, if not contradictory—at least on the surface—concerns and methods. These are subtle equilibriums because they are not always immediately apparent, especially as they can be played out on different spatial and temporal scales: intensifying production systems in one place to relieve the pressure on unique natural environments in another, combating an invasive species in one place, containing it in another,

sometimes letting it flourish; offering strong protection to an endangered population today, even if this means allowing its regulation tomorrow if its new-found abundance causes new nuisances. Subtle equilibriums inasmuch as they are often tricky to handle: if there are too many mosquitoes, eradication will be requested; if there are too few, insectivorous species will disappear; if there are too many short distribution channels, the possibility of helping people at the other end of the planet through fair trade will disappear; microbes are undoubtedly necessary—what would human beings be without the microbiota they harbour, and whose essential benefits we are only just beginning to understand?—but not too many, not always, not anywhere. Subtle equilibriums in that they are challenging to compose and must be juggled with conflicting modes of action and multiple strategic directions: protecting while welcoming the public or exploiting specific resources; regulating while allowing the emergence of innovations; assessing when necessary the monetary value of species or areas without losing sight of the priceless value of life. These subtle equilibriums manifest differently depending on place and time; they should be considered case-by-case, according to the context, dynamics and needs of living human and non-human beings.

When the current quickens, woe betide anyone who thinks they have found the right solution by rowing always on the same side; at best, they go around in circles; more often, they capsize. Progressing along the river of living things, embracing its turbulence and sudden accelerations, means paddling one stroke to port, one stroke to starboard. Subtle, etymologically 'under the fabric' (*sub-tela*), the dynamics of life are made from this double or bifid fabric.

Leveraging the territorial scale as a strategic asset

Critical levers for change still need to be found; levers likely to breathe new life into disappointing official strategies, in short, revitalising them. Not only because these strategies fail to curb biodiversity loss sufficiently but, more importantly, because they fail to mobilise more than a circle of specialists, government representatives and UN bodies. Designed for and by States, they de facto encourage a top-down and mostly prescriptive approach, which is hardly conducive to acknowledging and welcoming the ability of grassroots stakeholders to care for biodiversity. Furthermore, as we have shown, the methods they promote, however important they may be, do not ensure that subtle equilibriums will be sought and achieved.

What should be done then? For some, the hope lies in a principle of greater coherence: given the ecological imperatives and the social suffering brought about by the current mode of development, new criteria must be adopted at all decision-making levels, and in particular at the national and continental levels, so that only what is conducive to the pursuit of decent and healthy living may be preserved. Others feel that salvation will come from the local sphere: in the face of collective inaction, only a bottom-up takeover holds any promises, at the level of individuals themselves, small collectives created around shared interests, or even the re-localisation of production and trade. Finally, for others, the global nature of the problems and the imminence of the disaster that threatens warrant the appointment of new Olympians of expert knowledge above the rulers who are necessarily subservient to human interests in what could be likened to a world environmental organisation.

Comparing these active approaches shows that the transformation sought operates at different scales, involving many players and dimensions. It doubtless requires a complex response that can only be devised and put together by resolutely seeking to connect the different levels of responsibility and action. Here, then, is a first critical lever for change: we must establish bodies and procedures that facilitate meetings, cooperation and a much closer, adaptive and dynamic synergy around concrete problems or projects to enable the various players involved, regardless of the scale at which they operate, to jointly author a response, a systemic transformation to foster.

A second lever concerns what could be called 'the territorial level'. Do not look for it; international conventions and related processes ignore it unless they confuse it, from where they rule, with the 'local level'. It should also be distinguished from the concept of territory insofar as the latter refers to an established administrative and political entity or any 'portion of land area', to which it has become customary to add the idea of 'appropriation by a human group'. The territorial level stems from the observation that there is a strategic space, neither too close nor too far from the field, where inter-knowledge between players, the reasonable size and complexity of the area in question and the possibility of observing rapid feedback on initiatives undertaken and quickly correcting them will make it possible to tackle a variety of problems and challenges in an open, dynamic and creative way, drawing on very specific complementarities and synergies in situations of action. The territorial level is a game changer, considered a space or meso level for coordinating players with a

view to shared objectives or a joint project. It is a space where ecological parameters can be positively connected to the other data and aspirations of social life, whereas such a quest for pooling and harmony proves much more challenging to achieve at higher responsibility and action levels; a space where everyone can once again be a player and even co-creator of the quality of biodiversity, by taking part in a common, negotiated and stimulating project.

In an open world, it is evident that such organisations responsible for the quality of living things cannot be everything. This is where a final lever comes into play, likely to foster the convergence and coalescence of territorial initiatives, both among themselves and with initiatives at other levels: the contract. Rather than dedicated solutions, we should work with determination and enthusiasm on the emergence of processes that encourage the establishment of multi-stakeholder, multi-dimensional and multi-scale contracts.

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Biodiversity conservation calls for a revolutionary approach to our relationship with nature and the living world. But it also requires completely rethinking the way we develop international policies and strategies. While these instruments must deal with a highly complex reality, they are too often viewed as simple action plans. Measures and initiatives that are focused on mainly technical solutions eventually result in unfortunate setbacks when the often unpredictable and ever-changing dynamics of life come into play.

The United Nations Biodiversity Conference (COP15) was held in 2022, and despite the adoption of the Kunming-Montreal Global Biodiversity Framework, it failed to produce a truly innovative approach to international 'strategy'. It is therefore more necessary than ever to reconsider the official diagnosis that underpins international action. Although certainly difficult, this can be done by mobilising a wide range of expertise from different scientific communities.

Drawing on numerous examples and a wealth of research from the humanities, social sciences and conservation sciences, this book offers a profoundly renewed strategic diagnosis as well as levers for activating regenerative processes to benefit the living world.

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