

**Coviability of Social and Ecological Systems:  
Reconnecting Mankind to the Biosphere in an Era  
of Global Change**

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Editors

# Coviability of Social and Ecological Systems: Reconnecting Mankind to the Biosphere in an Era of Global Change

Vol. 1: The Foundations of a New Paradigm



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# Foreword: Coviability as a Premise of a New Shared Model for Sustainable Development by Jean-Marc Châtaignier

*« Rien n'est solitaire, tout est solidaire. L'homme est solidaire avec la planète, la planète est solidaire avec le soleil, le soleil est solidaire avec l'étoile, l'étoile est solidaire avec la nébuleuse, la nébuleuse, groupe stellaire, est solidaire avec l'infini. Ôtez un terme de cette formule, le polynôme se désorganise, l'équation chancelle, la création n'a plus de sens dans le cosmos et la démocratie n'a plus de sens sur la terre. Donc, solidarité de tout avec tout, et de chacun avec chaque chose. La solidarité des hommes est le corollaire invincible de la solidarité des univers. Le lien démocratique est de même nature que le rayon solaire ».*

“Nothing is isolated, everything is connected. Man is connected to the planet, the planet is connected to the sun, the sun is connected to the star, the star is connected to the nebula, the nebula, the stellar group, are connected to the infinity. Remove an element from this formula and the polynomial becomes disorganized, the equation staggers; creation loses meaning in the cosmos, and democracy loses meaning on earth. Thus, there should be solidarity

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Until September 2017 Jean-Marc Châtaignier was Executive Vice-President of the French Research Institute for Development (*l'Institut de Recherche pour le Développement*, IRD), which is an internationally recognized multidisciplinary organization, and whose partners are mainly countries located in the intertropical zone. IRD is a public institution under the simultaneous authority of the Minister of Higher Education and Scientific Research, and the Minister of Foreign Affairs and International Development. Through its network and its structured presence in about fifty countries, this institution represents an original approach to research, expertise, training, and knowledge sharing for the benefit of countries and territories that consider science and innovation the primary levers of their development. Jean-Marc Châtaignier is a former student of the National School of Administration (ENA – graduating class of Jean Monnet); he graduated from the Institute of Political Studies (IEP) of Bordeaux. Since 1990, he has held influential positions concerning development in France, Africa, and the United Nations. He was the Ambassador of France in Madagascar between 2009 and 2012, and Executive Vice-President of Globalization, Development, and Partnerships (DGM) between 2012 and 2014 at the French Ministry of Foreign Affairs and International Development. He wrote several articles on issues concerning international security, African politics, development, and governance. He has also published “L'ONU en Sierra Leone Les méandres d'une négociation” (2005) and “États et sociétés fragiles. Entre conflits, reconstruction et développement” (with Hervé Magro 2007), both published by Karthala. His latest book (ed.) is called “Fragilités et résilience, les nouvelles frontières de la mondialisation” (Karthala 2014).

between everyone and everything. Human solidarity is the invincible corollary for universal solidarity. The democratic connection is similar in nature to a solar ray". (Victor Hugo, *Proses philosophiques* (1860–1865))

We live in a permeable, unstable world where successive crises combine with increasingly complex threats. Our individual and collective social rules no longer seem effective against this "new international disorder." Humanity can no longer afford to focus on adaptation only. The unprecedented population boom that we have almost finished experiencing (1 billion people in 1800, probably between 10 and 11 billion in 2100) questions the survival of our species in an environment whose existence we have dramatically changed. With the new threats engendered by our industrial economic development, such as global warming and the most massive extinction of terrestrial and marine species since 66 million years ago, we have to invest time rebuilding our relationship with our planet to create conditions of a new *modus operandi*.

This volume investigates the coviability of ecological and social systems. Being the result of about twelve years of multidisciplinary research around the globe, it flourishes today to clarify the possibilities of a harmonious, peaceful, fair, and balanced life. It provides holistic markers of the changes and the evolutions noticed in the relationship between human and the world of animals, plants, and minerals, and the aquatic world. This innovative perspective is based on the cutting edge of research in various<sup>1</sup> and complementary domains.

The concept of viability originates from the mathematical patterns of control theory developed in the early 1990s by J-P Aubin.<sup>2</sup> This concept transcended several disciplines before developing and maturing by research programs on fragility and resilience. Emerging from the meeting point of the economic, social, and environmental pillars of sustainability, also related to the polysemous notion of sustainability, the concept of coviability is to participate in the elaboration of a new corpus of humanistic, social, and economic principles to take over social and liberal ideologies that are collapsing or in major crisis. It is implied in the book that the concept of coviability as choosing "the environment as a monitor for our development" becomes tangible and real, as stated by Johan Rockström, Director of the Resilience Research Center at the University of Stockholm.

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<sup>1</sup>Such as mathematics, geography, law, anthropology, biology, agronomy, ecology, political science, computer science, modeling, human and social sciences, economics, philosophy, hydrology, physics, chemistry, oceanography, electrical engineering, botany, entomology, ethnology, etc.

<sup>2</sup>See particularly Aubin, JP (1996) "A mathematical metaphor of the precautionary principle" *Nature Sciences Societies*, 4, 2, 146-154.

## The Limits of the Anthropocene, The Danger Facing Humanity

The winner of a Nobel Prize in chemistry, Paul Crutzen, suggests in a famous article published in 2002 by *Nature*<sup>3</sup> that 200 years ago the human condition mutated; it moved from an era called the Holocene to a new geological era, the Anthropocene, where humans developed the desire to construct and control their environment. If there is no rapid transmutation of this evolution, it will condemn humanity in an irreversible manner. The limits of this system are visible in the repeated ruptures and fractures that it undergoes with increasing intensity.

In “Le dérèglement du monde, quand nos civilisations s’épuisent,” which was published in 2009 (ed. Grasset), the Franco-Lebanese scholar Amin Maalouf also points out that the disorders present in all domains, be it intellectual, financial, climatic, geopolitical, ethical, are a sign that humanity reached the “threshold of moral incompetence.”

Johan Rockström reaches the same conclusions in his environmental research on the “Nine Planetary boundaries.”<sup>4</sup> With his coauthors, Rockström calls for a new model for the development of humanity in its planetary environment: “here is an urgent need for a new paradigm that integrates the continued development of human societies and the maintenance of the Earth system (ES) in a resilient and accommodating state” (Steffen et al. 2009, 736).

His most recent collective article, published in *Science*<sup>5</sup> in 2015, warns us against the extremely risky and critical situation of four of these nine limits. They are climate change, total change of the biosphere, biogeochemical flows, and the profound changes in terrestrial ecosystems.

Despite these disturbing conclusions, we cannot fail to notice the slow awakening of consciousness, of which the environmentalist candidate in the French presidential election of 1974, René Dumont<sup>6</sup>, was probably one of the most emblematic precursors. The movement is marked by the regular organization of environmental

<sup>3</sup>Crutzen P. (2002), « *Geology of mankind* », *Nature* 415, 23.

<sup>4</sup>Climate change; the change of the biosphere (loss of biodiversity and species extinction); the exhaustion of stratospheric ozone; ocean acidification; biogeochemical fluxes (phosphorus and nitrogen cycles); changes in terrestrial ecosystems (e.g., deforestation); the use of fresh water; atmospheric change to aerosols (microscopic particles in the atmosphere that affect the climate and living organisms); the introduction of new entities (e.g., organic pollutants, radioactive materials, nanomaterials, and microplastics) (Johan Rockström et al. (2009) « A safe operating space for humanity » *Nature* 461, 472-475 (24 September 2009) | doi:10.1038/461472a; Published online 23 September 2009).

<sup>5</sup>Will Steffen, Katherine Richardson, Johan Rockström, Sarah E. Cornell, Ingo Fetzer, Elena M. Bennett, Reinette Biggs, Stephen R. Carpenter, Wim de Vries, Cynthia A. de Wit, Carl Folke, Dieter Gerten, Jens Heinks, Georgina M. Mace, Linn M. Persson, Veerabhadran Ramanathan, Belinda Reyers, Sverker Sörlin, « *Planetary boundaries: Guiding human development on a changing planet* », *Science*, 13 February 2015, Vol. 347, Issue 6223.

<sup>6</sup>[https://en.wikipedia.org/wiki/René\\_Dumont](https://en.wikipedia.org/wiki/René_Dumont)

summits, the first taking place at Rio in 1992. Since then, annual conferences of parties are held to investigate climate change, preserve biodiversity, or combat desertification.

The state of our planet enjoins humans to stop their productive development and reproductive frenzy. We are not only facing an ecological crisis but an existential crisis as well.

## **A Collective Consciousness of the “Human-Nature” Unity Converted into Institutional and Legal Frameworks**

Being aware of an inevitable change, of our organizations, and our behaviors is translated into different social levels.

At the global level, this change was marked by an alteration of focus from the Millennium Development Goals, which is a referential framework of public development aid adopted at the Millennium Summit in New York in 2000, whose priority was the fight against extreme poverty; the aid was also given to the Sustainable Development Goals which was adopted by the UN General Assembly for the period 2015/2030, in an integrated, processed, and universal framework. For the first time, the human sustainability agenda is not limited to the citizens of the southern hemisphere only. Shared from Ouagadougou to Seattle, via Nouméa and La Paz, we are all responsible for bearing it. If the concept of coviability is not quoted as such in the 2030 calendar, it still establishes the philosophy and framework for renewed collective action.

Meanwhile, the actors of civil or transnational private societies (NGOs, companies, foundations, universities, think tanks, trade unions, etc.) are developing an increasing influence throughout the intergovernmental processes by means of consultation and lobbying processes. The upsurge of civil societies on the international scene of relations and regulations is unsettling the traditional diplomatic relations between States, especially as certain private actors do not hesitate to discard procedures that the States are supposed to respect. This gives them a feeling of power which the said actors sometimes use to excess. Nowadays, we face fierce competition between private actors and States. States lose the control of diplomatic action leading to a certain decline of sovereignty; it will in its turn serve as a ground for the development of nationalist and populist ideas, nostalgic of an often fantasized glorious past.

At the national level, an increasing number of laws revolving around energy, biodiversity, and the management of nonrenewable resource recognize the principles of interdependence and the necessity to protect the common public goods. The precautionary principle arises from a philosophical context to affirm itself in the international and European juridical norms, and to inscribe itself through the Environmental Charter in the French constitution in 2005.

The promotion of the institutional and legislative frameworks mentioned above requires appropriate conditions for fruitful dialogue and thinking along with skillful instruction in order to facilitate their development and application. Several chapters in this book tackle the environmental right from different perspectives; as they constitute the cradle of this progressing reflection. I particularly esteem the efforts of the researchers who investigated this issue: Olivier Barrière, Mohamed Benhassi, Thérèse Libourel, Aline Treillard, and Jessica Makowiak.

## **The Consciousness of Our Civilization of an Ecological Action Based on the Cutting Edge of a Multidisciplinary and Global Research**

The complex and occasionally conflictual contemporary context in which we have to survive requires an integrated scientific interpretation capable of reaching private and public decisions. Through a collective and coordinated method, this scientific clarification should help in addressing the set of new challenges our planet faces, challenges related to living with others and living harmoniously within ecosystems.

Scientists contribute to anticipating and measuring risks through the production and selection of indicators shaped by data that result from observations of the earth. They offer solutions concerned with adaptation or reduction while keeping up with changes in order to appraise and follow public decisions. The case studies presented in this book illustrate the cross-sectoral articulation and the applications of this process, be it in Amazonian farming borders, protected marine areas in Brazil, national parks in South Africa, or the Mediterranean pastoral ecosystems.

Managing migration, mitigating climatic change, conserving biodiversity, removing carbon from soils, building a genuine transitory energy, and managing global health crises are also themes involving the concept of coviability.

## **Calling for a Coalition for Coviability**

This volume thus invites us to step beyond models marked by competition or simple coexistence. It offers the opportunity to adopt a new collective, holistic, essential, and unique model: “the coviability of social and ecological systems.”

This volume addresses our collective understanding both in the actual sense of the word, as it calls for a “Right understanding,” and in its etymological sense of *interegere* which denotes “recreation of links.” We simply need to reconnect to the ecological system in which we are born and to which we are connected. At the dawn of a new era, we have the responsibility of combining our efforts and intentions to follow this conceptual change in order to solitarily thrive by means of scientific guidance.



To conclude, I quote once more Amin Maalouf who suggests that « *les seuls vrais combats qui méritent d'être menés par notre espèce au cours des prochains siècles seront scientifiques et éthiques* » [*In the coming centuries, the only real battles worth fighting for by our species will be scientific and ethical.*"]

French Ambassador, Special Envoy for the  
Sahel since October 2017  
Until October 2017, Vice-President of the  
french Institute of Research  
for Sustainable Development (IRD), France

Jean-Marc Châtaignier

# Foreword: The Coviability New Humanistic Paradigm by Philippe AUGE

“How to unite nature and society, human and non-human, individuals and groups, in a new assembly where they would no longer present themselves to us as comprising substances, processes and simulators, but as the established expressions of relations between multiple entities whose ontological status and capacity for action vary according to the positions they occupy in relation to each other?” Such is the question of Philippe Descola, in *L'écologie des autres. L'anthropologie et la question de la nature. 2011* (The ecology of others. Anthropology and the question of nature).

The collective work “Coviability of Social and Ecological Systems: Reconnecting Man to the Biosphere in an Era of Global Change” aims to answer this question through more than fifty articles from various scientific fields: ecology, health, mathematics, computer science, geography, human and social sciences, anthropology, environmental law, and philosophy. Under the leadership of the publishing collective (Olivier Barrière, Mohamed Behnassi, Gilbert David, Vincent Douzal, Mireille Fargette, Thérèse Libourel, Maud Loireau, Laurence Pascal, Catherine Prost, Voyner Ravena-Cañete, Frédérique Seyler, Serge Morand), the authors from different corners of the world have exchanged their points of view from the first writings and ideas emanating from theoretician colleagues (Aubin<sup>1</sup>, Bourguine<sup>2</sup>) or from environmental colleagues, modellers, and economists (coviability of fisheries systems IRD and SHS<sup>3</sup> project). About twenty faculty members and researchers from four research units at our university are involved and have strong links with their international colleagues to make sense of the coviability paradigm.

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<sup>1</sup>Aubin, J.P. (1991), Viability theory, Birkhäuser, Boston.

<sup>2</sup>Bourguine Paul (1996) Models of autonomous agents and their co-evolutionary interactions, Thinking the Spirit: from the Sciences of Cognition to a Cognitive Philosophy, V. Rialle and D. Fiset (eds), University Presses of Grenoble, pp. 421-443

<sup>3</sup>Le Fur, Curry, Laloe, Durand, Chaboud (1999) Co-viability of Fisheries Systems, Nature Sciences Societies, vol. 7, No. 2, 19-32

The intended ambition is to start from the concept of viability introduced by Aubin to reach an innovative paradigm, politically and ideologically neutral. But a paradigm from the world of research can contribute to the prospect of the ecological future of the planet.

In a way, the contribution of researchers, in addition to analyses, diagnosis and technical solutions, a sociopolitical and legal framework is defined, making humans responsible for their choices towards their habitat.

## **Reconnecting Human to the Biosphere**

At the end of the war, in 1945, Vladimir I. Vernadsky wrote in *American Scientist*,<sup>4</sup> in a premonitory way:

In the thick of life today, intense and complex as it is, a person practically forgets that he, and all of mankind, from which he is inseparable, are inseparably connected with the biosphere [ . . . ] Man is an element which cannot be separated from the biosphere. And this inseparability is only now beginning to become precisely clear to us. In reality, no living organism exists in a free state on Earth. All of these organisms are inseparably and continuously connected.

However, our will and our understanding can regulate the course of phenomena in the future. The stakes are high: regulate threats and find a harmonious compromise to ensure the global viability of the Earth system.

As a legal expert, I measure all research and proposals in social sciences that can bring a compromise between the human and the nonhuman. Suggestions are presented in this book and there is no doubt that the training courses and laboratories of our university will contribute to these challenges related to the law, protection, and management of the environment in these various facets.

The University in Montpellier was born and flourished by the merit of shared teaching by experts from diverse backgrounds and diverse cultures. They have met in Montpellier since the twelfth century to create in this city, a university that overtime has always been able to promote strong scientific, humanistic, and cultural links with all research centers in and beyond Europe.

The academic history of the city has been demonstrated in the medical field since 1180 with the edict of the lord of Montpellier Guilhem VII liberalizing the teaching of medicine. Forty years later, in 1220, the Pope's legate, Cardinal Conrad d'Urach officially founded the School of Medicine, which is the oldest in the Western world, still in practice. The University of Montpellier was officially created in 1289 by Pope Nicholas IV bringing together the teaching of medicine, law, literature, and theology.

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<sup>4</sup>Published in *American Scientist* in January 1945 "La Biosphère et la Noosphère."

In the sixteenth century, the city of Montpellier became a high-level intellectual center and confirmed its position as a European crossroads of law and medicine. At that time, it attracted many scholars and scientists who shared humanist values, including François Rabelais, Guillaume Rondelet, and Pierre Richer de Belleval.

The University of Montpellier was awarded original subjects: anatomy, botany, biology, etc. Close to medicine, the study of medicinal plants spread more and more in Montpellier with the creation of the Jardin des Plantes, in 1593 by Henri IV, the oldest official botanical garden in France, forty years before Paris. The first masters of Parisian botany were trained in Montpellier, notably by Pierre Magnol. The city was considered the capital of botany until the eighteenth century.

The scientific landscape of Montpellier changed at the beginning of the nineteenth century with the creation of the Faculty of Sciences in 1809. It was endowed with seven master chairs: transcendental mathematics, astronomy, physics, chemistry, zoology, botany, and mineralogy.

Divided into three universities after 1968, the University of Montpellier was merged in January 2015 with UM1 and UM2. Today, with 16 training and research units (*Unités de formation et de recherche* -UFR), schools and institutes, 77 research structures grouped into 9 scientific departments, more than 45,000 students, and 4,500 civil servant workers, it is the largest university in the Occitanie region and the 6th largest in France.

The list of scholars, masters, and students of our university who, over the centuries, have distinguished themselves by their decisive contributions in mathematics, medicine, botany, law, chemistry, etc. is long.

The initiative of this book is therefore part of this tradition.

Our most famous scientific and humanist student was François Rabelais. I will paraphrase it<sup>5</sup>: “Do as you please but do not forget the crux of the matter” by reading the text of this book to find some of the spirit that will make our future more coviable.

Coviability is the business of each and everyone of us.

Our university has just been labeled “I-site” in February 2017 through the MUSE project, promoting transdiscipline and aiming to become a recognized center of excellence around major societal challenges: contributing to food security; managing sustainably the natural resources and ecosystems; and improving the treatment of emerging infectious diseases, chronic diseases, or cancers. There is no doubt that researchers from the University of Montpellier have worked and will continue to work to make our world more coviable. Our university is aiming to create added value from interdisciplinary work and interactions with international researchers.

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<sup>5</sup>Rabelais, François, and Pierre Grimal. *Gargantua*. A. Colin, 1964. Prologue de Gargantua « A l'exemple d'icelluy vous convient estre saiges, pour fleurir, sentir et estimer ces beaulx livres de haulte gresse, legiers au prochaz et hardiz à la rencontre; puis, par curieuse leçon et meditation frequente, rompre l'os et sugger la sustantifique mouelle – c'est à dire ce que j'entends par ces symboles Pythagoriques – avecques espoir certain d'être faitz escors et preux à ladictte lecture ».

Philippe AUGE, professor of Public Law, was President of the University of Montpellier 1 from 2009 to 2014. Since January 2015, he is President of the University of Montpellier (the University of Montpellier results from the UM1 and UM2 merger).

# **Foreword: Preserving Ecological and Human Viability by João Carlos Salles Pires da Silva**

In a more sustainable world, the concept of coviability is emerging as a concept to respond to humanity's current global concern about its future. Coviability forces real challenges to the future of humanity, and demands attention to all types of inter-relationships existing on a global scale, so that life oriented by the logic of "development" of a few does not interfere negatively on the way of life of other social groups, leading to uneven development and increasing exclusion. In fact, despite official discourse on environmental protection, the logic of development that is promoted and perpetuated reveals a lack of recognition for much of the rights of Nature..

Coviability invites us therefore to rethink the relationship between society and Nature, in order to preserve ecological and human sustainability in its various dimensions—economic, social, cultural—thus demanding a huge effort in order to build a dialogue between the empirical knowledges and the different areas of science, in search for the analysis and solutions to the problems.

Nearly 25 years after Rio 92, and despite considerable efforts by researchers to define and evaluate the concept of sustainable development, there are still serious limitations in the effective implementation of actions; environmental problems are increasing and directly affect societies and their various socio-cultural groups. In this sense, consideration and actions based on coviability invite us to listen to other representations and relationships with Nature, in order to inspire us on the building of more harmonious ways of life. Therefore, the participation and dialogue between researchers from the most diverse corners of the world become important so as to enable diverse viewpoints to be considered, from those of industrialized countries to those of the many traditional populations, with their symbolic representations and specific production practices.

In line with the academic tradition of the Federal University of Bahia in its various fields of research, and based on its dialogue with various segments of society that sustain and legitimize our Institution, I take this opportunity to reiterate my support to the members of UFBA, congratulating those who enthusiastically engaged themselves in this project.

Rector of the Federal University of Bahia  
Salvador, Brazil

João Carlos Salles Pires da Silva

# **Preface: Coviability, the First Step in a Long-Overdue Need for Coherence in Our Living with Nature by Daniel W. Bromley**

An enduring challenge to students of ethics is the question—“Ought I to do what I can do?” The question cuts to the heart of modernity, for it challenges the alleged autonomy of the individual embedded in a social context. Indeed, my question challenges the fundamental idea of what it means to be an individual. In the limit, the autonomous individual is a fiction—an artifact of the thrilling hedonism of the Enlightenment. That stark philosophical break with tradition, the ideational “creation” of the individual, has brought mixed results to the human community—and to the physical world we so uneasily inhabit. That fateful project of conjured individuation now stands before the Alter of History as an existential threat to the future of humanity. The acquired arrogance of the artificial yet autonomous individual has not freed humans from the historic bondage of superstition, original sin, and obligatory guilt. It has rather transformed that bondage into fealty to other superstitions, other sins, and serial penance so that the next conquest might then come clearly into view—and within reach. We may now purchase “carbon credits” before, not after, our next gratuitous airplane trip.

In the Prelude to my 2006 book *Sufficient Reason: Volitional Pragmatism and the Meaning of Economic Institutions* (Princeton University Press), I offered the following comment on the presumed autonomy of the individual:

It may be supposed that the most fundamental of human needs concerns food, water, and staying warm. This supposition would be mistaken. The most funda-

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Born in 1940, Daniel W. Bromley’ research fields include the institutional foundations of the economy property rights; the economics of natural resources and the environment; and economic development. He has been editor of the journal “[Land Economics](#)” since 1974. Since 2009, Bromley is Visiting Professor at the Faculty of Agriculture and Horticulture of the Humboldt University of Berlin, [Germany](#). In 2011, he was honored with the Reimar Lüst Prize for International Transfer of Science and Culture awarded jointly by the German Alexander von Humboldt-Stiftung and the Fritz Thyssen-Stiftung. Daniel Bromley is a Fellow of the Association of Environmental and Resource Economists, the American Agricultural Economics Association, and is listed in Who’s Who in Economics. At last, he is the recipient of the Veblen-Commons Award from the Association for Evolutionary Economics.



mental human need concerns what to believe. Believing is precedential to eating and drinking (and staying warm) for the simple reason that even the seemingly basic acts of eating and drinking require a concept about surviving and thereby experiencing the future. This attribution of value to the future is what renders survival a conceptual rather than a physical matter. Without the idea of the future, and without the attribution of value to the future, eating is not an obvious or compelling activity. Eating requires the will to live.

With the future driving actions in the present, believing becomes the predicate for all action. What should I eat? What should I drink? How might I stay warm? From this one may further suppose that believing is an individual enterprise. This supposition, too, would be mistaken.

As social beings we tend toward, indeed we are defined by, social beliefs. The essence of socialization is precisely the stabilization of beliefs. And stabilized beliefs define for us what is normal, natural, correct, right.

It could not be otherwise.

And from this spare beginning one can begin to make out the ground beneath the social arrangements—the institutions—that define our very being as social creatures . . .

There is no such thing as the individual—we only assume that to be the case. And of course it is this presumptive deceit that now stands indicted in our collective inability, our arrogant unwillingness, to live within—and at peace with—our natural surroundings. I stress here the problematic individual because too often the problem as laid at the feet of some abstraction called “society” or “communities” or “capitalism.” These labels are mere bait to throw us off the scent of the deeper problem. Societies or communities or capitalism are not volitional agents. And of course when the active agents are finally located, they will appeal to their rights or their freedom. They will never admit to self-interest.

The project before us offers new and nicely creative ways to remind us of how hard it is to rein in the alleged autonomy of the individual so that we can, collectively and individually, exist and thrive within a biosphere that has its own ideas. The environmental ethics community has tried, for several decades now, and with indifferent success, to convince the arrogant individual that we must be nice to nature. Only our abiding “false consciousness” impedes progress on that front. Not the false consciousness of Marx, but the false consciousness of our own gilded creation myth.

The coviability approach brings us a wealth of insightful scholarship on an age-old challenge. By stressing the mutual viability of the two distinct domains, we gain a new perspective on how hard it will always be to bring the desired consilience (with apologies to E.O. Wilson). It will be hard precisely because the agents in each system operate on contrary logics. The biosphere operates on the logic of function, while the human system operates on the logic of purpose—an end in view. Humans deny the centrality of function because we see the biosphere as an entirety—an “other”—rather than as interconnected thrusting entities. The biosphere cares little for our fickle and self-serving purposes. Therein lies the eternal conflict.

Coviability wants to help us see those conflicts and modify our purposes accordingly. I like to think of the coviability project as the first step in a long-overdue need for coherence in our living with nature. Distinct moving parts cohere when they fail to clang and clash and resist. They become one out of many.

Professor of Applied Economics (Emeritus)  
University of Wisconsin-Madison, Editor *Land Economics*

Daniel W. Bromley

# Acknowledgments

This contributed volume is the outcome of a long process of teamwork, seminars, and an international conference on Human and Environmental Security in the Era of Global Risks held in 2015.<sup>1</sup> The content and approach of this publication are mainly based on the empirical research undertaken by the majority of coeditors and chapter authors, highly aware to local and global ecological and social challenges.

From 24 to 28 November 2014, a seminar held in the Cévennes (Valleraugue, located in the south of France) made it possible to draft the first editorial roadmap by addressing the following theme: “The negotiated territorial regulation for the coviability of social and ecological systems: between concepts and transdisciplinary experiences.” From this starting point, the idea to edit this volume emerged and subsequently urged on by my partner Serge Morand who is a bioecologist. The team was quickly formed thanks to existing partnerships with Mohamed Behnassi (Specialist in Environmental Law and Governance, Morocco), Voyner Ravena-Cañete (Anthropologist, Brazil), and Catherine Prost (Geographer, Brazil). The team was further extended to include Laurence Pascal (Biologist, France), Thérèse Libourel (Computing Scientist, France), Maud Loireau (Geographer, France), Gilbert David (Geographer, France), Mireille Fargette (Bio-Geographer, France), Vincent Douzal (Mathematician, France), and Frédérique Seyler (Hydrologist, France). This international Editorial Board was supported by the UMR ESPACE-DEV, French National Research Institute for Sustainable Development (IRD),

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France, which managed to involve other partners – such as the Universities of Montpellier, Guyana, Reunion, and the West Indies, Antilles. This research unit has even integrated a new transversal research area within its program, labeled “Coviability,” a move which helped support the entire editorial process.

This interdisciplinary work focuses on the links between humans and nonhumans (the natural environment) and the interrelations between culture and nature. The core theme of this publication is timely and complex that the objective of founding a new paradigm was a real challenge in scientific, human, and editorial terms. The important number of coeditors, six women and five men, reflects the need to involve a variety of disciplines and institutions in this transversal and interdisciplinary research enterprise.

Such an editorial team has managed to ensure the depth, relevance, and accuracy of the analysis both theoretically and empirically. The open-minded spirit of all coeditors enabled relevant scientific approaches to address the question of coviability. Based on this, I wholeheartedly thank all the members of the Editorial Board for their trust, perseverance, and valuable contribution making the whole publishing process a true success.

I also pay tribute to the IRD and the University of Montpellier, two French leading institutions. Without their support, it would not have been possible to complete this project.

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Finally, the achievement of this substantial publication (over 1200 pages, 43 chapters) in two volumes is the result of the outstanding participation of over a hundred researchers from various disciplines and research institutions around the world. On behalf of the Editorial Team, my thanks and recognition are extended to all researchers, the contributions of whom have served the relevance, the originality, and value of this timely publication.

Montpellier, France

Olivier Barrière

# General Introduction

Today's planetary challenge is to profoundly revise existential paradigms. (Dalai-Lama and Stril-Rever 2016)

## Introduction

The planet Earth has entered a new geological era. The International Geological Congress held in Cape Town, South Africa, on August 29th, 2016, voted for the “official” switch from the Holocene Epoch (10,000 years ago) to the “Human Epoch” (Crutzen 2002; Monastersky 2015), or Anthropocene Epoch.<sup>1</sup> Human activity imprints the geology of the planet Earth and is measured by indicators found in lake sediments, Antarctic ice cores, corals or tree rings. Evidence of anthropogenic impacts refers to the rise in sea level, global temperature, the atmospheric concentration of greenhouse gases (including carbon dioxide CO<sub>2</sub> and methane CH<sub>4</sub>), biological changes (extinctions of species, global species migrations, loss of biodiversity), changes in the oceans, and so forth. It also refers to the physical changes of the continents (erosion of soils and shorelines, plundering of land, sediment production, occupation and modification of areas through urbanization, intensive agriculture, deforestation, land degradation, and so forth): “sufficient evidence has emerged of stratigraphically significant change (both elapsed and imminent) in recognition of the Anthropocene Epoch—currently a vivid yet informal metaphor of global environmental change—as a new geological epoch

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<sup>1</sup>Stratigraphic recognition is set to be validated by the International Union of Geological Sciences (IUGS) during the next three years. The definition of the “Anthropocene Epoch” can apply three levels: (a) the new geological time interval (Rudwick 2005); (b) the Earth system which has left the Holocene Epoch: “the Anthropocene Epoch is not about being able to detect human influence in stratigraphy, but reflects a change in the Earth system” (Zalasiewicz 2014) ; and (c) the human footprint: the consideration of transformations made directly to landscapes, the extinction of species, the nitrogen cycle, etc. (Syvitski 2012).

to be considered for formalization by international discussion. The Anthropocene Epoch may be defined by a GSSP (Global Stratotype Section and Point) in sediments or ice cores or simply by a numerical value” (Zalasiewicz et al. 2008, 2010, 2014). However, from the mid-twentieth century, other markers appeared, such as micro-plastics, pesticides, concrete, or radioactive elements (Vince 2014, Bonneuil and Fressoz 2016).

One of the most striking features of the Anthropocene Epoch is the ability of human to occupy and transform the planet at a rapid rate, with a greater intensity and uncertain consequences. This is accompanied by the notion of global environmental crisis which is leading us to rethink modernity (Hamilton et al. 2015). Climate change represents the most obvious manifestation of this transformation. As highlighted in the 5th report of the Intergovernmental Panel on Climate Change (IPCC 2014): “Human influence on the climate system is clear, and recent anthropogenic emissions of greenhouse gases are the highest in history. Recent climate changes have had widespread impacts on human and natural systems. (. . .) Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and oceans have warmed, the amounts of snow and ice have diminished, and sea levels have risen.”

In 1950, 2.5 billion men and women inhabited the planet. Forty years later, by the time of the 1992 Earth Summit in Rio de Janeiro, which adopted the United Nations Framework Convention on Climate Change (UNFCCC),<sup>2</sup> the world population had doubled to reach almost 5.5 billion human beings. When the Paris Agreement (COP21) was signed on December 12th, 2015, there were between 7.3 and 7.4 billion people living on our planet and GHG emission had never been higher (Blunden and Arndt 2016).

## **Realization of a Planetary Ecological Emergency**

The pressures that human exerts on the planet contribute toward defining an ecological emergency that penetrates collective consciousness and is a cause for concern among a large number of players throughout the world. While international environmental law has adopted treaties and multilateral agreements for more than forty years now, the watchword of “ecological emergency” is recent. In addition, in 1995 for example in Chicago, the Parliament of the World’s Religions<sup>3</sup> warned:

<sup>2</sup>Adopted by 154 States in Rio de Janeiro (Brazil) during the 1992 Earth Summit. It came into force on 21 March, 1994.

<sup>3</sup>The Parliament of the World’s Religions “aims to establish a global interfaith dialogue. Its origin dates back to September 1893 when it first met in Chicago. It re-emerged in 1993 with a meeting in Chicago, and then every five years: 1999 in Cape Town, 2004 in Barcelona, 2009 in Melbourne, and 2015 in Salt Lake City. This Parliament of Religions is not an institution but a process of dialogue, open to the religious and philosophical convictions of the whole world. A longside representatives of religions and believers, humanists are involved in the preparations and participate in events. It

“the world is in agony, a general and dramatic agony: the planet is gradually being destroyed; its ecosystem is endangered. Anarchy and violence are threatening our societies. We must respect the entire community of living beings: humans, animals, and plants. We must turn our attentions to protecting the planet, its atmosphere, soil and water” (Küng and Kuschel 1995).

This realization is universally shared thanks to a variety of initiatives, such as the “Summit of Consciences” held on July 21th, 2015, in Paris which brought together more than forty moral and religious figures from around the world in response to the international campaign “The climate, why do I care?” and to launch a “Call to Conscience for the climate.”<sup>4</sup>

The Paris Political Agreement, adopted within the framework of the UNFCCC (COP21 December 12<sup>th</sup>, 2015), and which brought together 195 States, acknowledges that “climate change represents an immediate and a potentially irreversible threat to human societies and the planet.” The relationship between mankind and the planet Earth defines a Man-Nature unity which was emphasized by the World Charter for Nature as early as 1982 (adopted by the General Assembly of the United Nations on October 28th, 1982): “Humanity is part of Nature”; and the latter has “shaped human culture.”<sup>5</sup>

The symbiosis described by the West<sup>6</sup> comes within the following definition of nature: “the set of conditions of human nature itself, its global renaissance or extinction constraints, the hotel which provides it with a roof, warmth and food. Moreover, it takes it all away as soon as it is taken advantage of. It conditions human nature which, from now on, conditions it in return. Nature behaves like a subject” (Serres 1992, 64). This nature/subject<sup>7</sup> paradigm leads to the idea of a community of living beings, humans, and non-humans, which is crystallized in the planet Earth personified by “Gaia” (Lovelock 1979) and through a draft Universal Declaration of the rights of “Mother Earth” (2010)<sup>8</sup>: “recognizing that Mother Earth

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is a place of meeting for people of faith and convictions, face to face, heart to heart. Every meeting brings together some 10,000 people of all religious and “cultural traditions.””

<sup>4</sup><http://www.whydoicare.org/en/summit-of-the-consciences-for-the-climate>

<sup>5</sup>It is important to emphasize that this nature/culture division, which determines reflection and the position taken regarding the condition of Man as a being integrated into nature, is anchored in a dichotomy conceived by Western rationale. Strathem (2014) points out that such dichotomy does not exist in any other human group. This also implies that the idea of reconnecting Man with the biosphere is a Western invention. Such an affirmation underlines the imposing and hierarchical character which models the reconnection itself, which only occurs because the Western world considers the biosphere to be disconnected from humans; in reality, it thinks of it in a dichotomous manner.

<sup>6</sup>Humanity has various ways of thinking, of being and of seeing the world, so it would be preferable to talk about humanities. These sociocultural differences mean that by definition, discourse cannot be universalist; see Strathem, 2014.

<sup>7</sup>On nature as a subject of rights, see: Rühs and Jones, 2016; Laastad, 2016; Hermitte, 2011; Regarding perspectivism, see: Viveiros De Castro, 2009; 2014, and Perez, 2010.

<sup>8</sup>From the «World People’s Conference on Climate Change and the Rights of Mother Earth», held in Cochabamba, Bolivia, between April 19 and 22, 2010.

is an indivisible community of diverse and interdependent beings with whom we share a common destiny and to whom we must relate in ways that benefit Mother Earth.”

Politicians, members of religious communities, and citizens are joining forces around the challenging issue of Man’s relationship to his habitat. Awareness of this issue is affecting ethics and is taking shape owing to political decisions which are transformed into laws on the basis of scientific alerts. In this way, the Intergovernmental Scientific and Political Platform on Biodiversity and Ecosystem Services (IPBES<sup>9</sup>) stresses the risks linked to the disappearance of pollinators for biodiversity and global agriculture and advocates a “transformation of society’s links with nature” by making sure that human populations are aware of the values of pollination and by establishing “links between human populations and pollinators” (IPBES 2016: 25). These relationships go so far as to define a “biocultural diversity,” which IPBES presents as the links between cultural and biological diversities.<sup>10</sup>

The linking of culture and biodiversity is not only ideological (see Maffi 2005, Maffi and Woodley 2010) or limited to certain societies. If we accept to disengage from the so-called Western naturalist ontology (Thomas 2011, Kholer 2011), biocultural diversity<sup>11</sup> could be conceivable in societies all over the world. This notion, widely promoted by the International Union for the Conservation of Nature (IUCN 2010) with regard to traditional societies that are erroneously presupposed “by nature” to be respectful of the environment, can break free from the sole context of indigenous or so-called traditional populations; owing to the fact that “bio-cultural diversity is not external to us: it is the total sum of nature and culture...” (Maffi and Woodley 2010), which Christophe Grenier qualifies as geodiversity (1998, 2003). Such respect, which seems to be “derived from nature,” is in fact the product of the longstanding companionship between nature and culture, a biocultural symbiosis.

## **The Biosphere: The Focus of Life**

This “sum of nature and culture” derives from reciprocal interactions that unite living beings within the biosphere. In 1926, the notion of biosphere was defined in a biogeological and ecological sense by Vladimir Ivanovitch Vernadski, who hypothesized that life is a geological force that transforms the Earth. He was the first to scientifically consider the impact of human activity on the climate, at a time when natural resources were thought to possess inexhaustible regeneration capacities. The

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<sup>9</sup>Intergovernmental Science–Policy Platform on Biodiversity and Ecosystem Services.

<sup>10</sup>“A certain number of cultural practices based on indigenous and local knowledge contribute towards maintaining an abundance and diversity of pollinators and a “biocultural diversity” the value of which is appreciated (in this assessment, biological and cultural diversity and the links between them will be referred to as “biocultural diversity”)” (IPBES 2016, 11).

<sup>11</sup>See the introductory chapter which explains this concept.



concept of biosphere was born from a multidisciplinary approach that namely brings together naturalists, geologists, and biologists.

For Vernadski, the biosphere is “the unique region of earth’s crust which is occupied by life. It is only in the biosphere, a thin outer layer of our planet, that life is to be found. All living organisms are found here and are always separated from surrounding raw material by a clear and insurmountable limit. (...) All life, all living matter may be considered as an indivisible whole in the mechanism of the biosphere” (Vernadski 2002 (1929), T19 and T22). The author clearly stresses the limitations of the development of life owing to the finite dimensions of the planet and the physicochemical constitution of its environment (Vernadski 2002/1929)<sup>12</sup>.

## Human Development: How and in Which Direction?

By definition, the human being is an integral part of the biosphere. From an anthropological point of view, the intertwining of Man and the biosphere reflects a mental representation of the relationship between social systems and ecological systems; a connection which maintains the more or less clear distinction between human and nonhuman. This representation depends on rational thought, ethics (values), a cultural pattern leading to the paradigm of the Man-biosphere relationship. In this time of global change, which includes environmental changes, the ecological stake becomes essential. The reasoning behind the objective of “viable/sustainable development” is confronted with two unavoidable obstacles: that of the “development” model and that of its temporal perspective: how far and until when?

The question of the development model becomes paramount since it directly affects the relationship between Man and the planet and, consequently, Man’s place *vis-à-vis* the biosphere. Owing to its responsibility for the Anthropocene Epoch, humanity finds itself in an ecological emergency that requires adaptations, transitions, and ruptures. For the past forty years, the prospect of “sustainable development” has been perceived as a recurring leitmotiv and the only statement of a new relationship with our Planet. However, are we convinced of the necessity to leave the Anthropocene Epoch for another era,<sup>13</sup> unifying Man in the biosphere from which, “by nature,” he cannot exclude himself?

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<sup>12</sup>For the author, the elements of the biosphere are divided into three groups: living matter (autotrophic species and heterotrophic organisms); biogenic matter (fossil fuels, peat, humus); and bioinert matter (including water, low atmosphere, sedimentary rocks). A protective ozone shield serves as an upper limit to the biosphere. The laws governing biosphere organizational processes are mainly the biogenic migration of chemical elements and the evolution of species (Vernadski, 2002/1929).

<sup>13</sup>It could be the noosphere (sphere of human thought, Vernadsky 1945, Teilhard de Chardin 1956; Grenier 2000), but in this context we remain in a very anthropocentric logic.

The grip of humanity on the planet is pushing mankind toward an obligation of “planetary stewardship” in order to ensure his survival. Does the human viability stake therefore relate to human’s own “development,” or rather to his capacity to adapt to himself and to the transformations of his environment (Toussaint et al. 2012)? The basis of life lies in a limitless continuity, that of “persisting” (whilst remaining sustainable). Consequently, should planetary stewardship consist in inexorably pursuing demographic, economic, technological growth, etc.?<sup>14</sup> The need to break with consumerist rationale is obligatory in order to permit the emergence of a social resilience and adaptive capacities through an economic and ethical re-founding of societies. Societies subjected to globalization suffer from ecological constraints which define the limits and fragilities of the planet, developed by human and for human justifying a stewardship on this scale: “the advent of the Anthropocene Epoch, the time interval in which human activities now rival global geophysical processes, suggests that we need to fundamentally alter our relationship with the planet we inhabit. (. . .). The Anthropocene Epoch is a reminder that the Holocene Epoch, during which complex human societies have developed, has been a stable, accommodating environment and is the only state of the Earth System that we know for sure can support contemporary society. The need to achieve effective planetary stewardship is urgent. As we go further into the Anthropocene Epoch, we risk driving the Earth System onto a trajectory towards more hostile states from which we cannot easily return” (Steffen et al. 2011).<sup>15</sup>

The ecological stake becomes an issue of unity based on the interdependence of human systems with ecological systems, and owing to this, an issue of reciprocity. Rethinking humanity in terms of the biosphere is a way of reconnecting with it (as presented below in Part 1), but this remains dependent on a paradigmatic relationship (as presented below in Part 2). The objective of this work, the outline of which we will present (in Part 3), consists in bringing to light the definition of a concept and the formalization of a paradigm of socioecological unity.

## **Reconnecting Human to the Biosphere**

“We are the first generation with the knowledge of how our activities influence the Earth System, and thus the first generation with the power and the responsibility to change our relationship with the planet” (Steffen et al. 2011).

When we speak of reconnecting human to the biosphere, it implies that a disconnection has occurred. By directly taking action, by becoming a player in the

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<sup>14</sup>See “Is there a limit to the evolutions of man?” (Toussaint 2012).

<sup>15</sup>And for the poet Friedrich Hölderlin (1968), “there are two ideal states: extreme simplicity, where owing to natural organization alone, without our involvement, our needs are in accord with themselves, and extreme culture, where the same result is attained thanks to the organization that we are capable of giving ourselves.”

geological transformation of the planet Earth, humanity believed itself to be free of its relationship with other living beings. By becoming the master of his own destiny, *Homo sapiens* has “moved away” from his origins, from the original matrix which saw his creation. The beginning of the Anthropocene Epoch dates from this break, from this “disconnection.”

Becoming stewards of the Earth system by conforming to a new social contract for “global sustainability” (Carl Folke et al. 2011) would define humanity’s survival objective. Achieving this means rethinking our relationship with the biosphere, repositioning mankind in his role and his place on the planet. It is certain that reconnecting human to the biosphere requires a balanced management (responsible) of the planet’s resources and implies considering the limits which it can tolerate (Jansson et al. 1994; Rockstrom et al. 2009). However, achieving this planetary stewardship objective is not necessarily based on the paradigm of the economy which confers the status of “natural capital” to nature. A status which was established by IUCN during the “World Conservation Congress” held in Hawaii, Honolulu, from September 1–10, 2016.<sup>16</sup> A “Natural Capital Protocol”<sup>17</sup> is being developed internationally (Natural Capital Coalition 2016). The nature paradigm, seen as “our most important bank account,” is being promoted by the Capital Natural Project<sup>18</sup> from a human well-being perspective, by integrating the value that nature represents for society.<sup>19</sup> This approach is supported by Stanford University, the University of Minnesota, The Nature Conservancy, and the World Wildlife Fund.

The biosphere functions through interactions and interconnections. The latter, between local and global levels, contribute toward the human footprint on the planet,

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<sup>16</sup>“Understanding that the aim of natural capital approaches is to make the value of nature more visible in decision-making by governments, businesses, financial institutions and society, and to drive better outcomes for biodiversity, the environment, and human well-being (...) Acknowledging Council Decision C/84/16 outlining a roadmap to develop an IUCN policy on Natural Capital” (Declaration of the congress entitled “Planet at the crossroads” with the objective of “securing systems that support nature so that humanity and the community of life as a whole continues to thrive on Earth. This is our collective challenge for the next 15 years and this is the challenge that the 2016 IUCN Congress is proposing to the world to meet.” IUCN, September 1st to 10th, 2016.

<sup>17</sup>The Natural Capital Protocol is a standardized framework which will permit companies from all over the world to understand and quantify their impacts and dependencies on natural capital, launched on July 13th, 2016, in London by two consortiums, WBCSD and IUCN. The WBCSD consortium comprises Accenture, ARCADIS, The B Team, Climate Disclosure Standard Board, Conservation International, Deloitte, eCountability Ltd, eftec, ERM, GIST Advisory, Imperial College, Integrated Sustainability Services, Natural Capital Project, PwC, Sustain Value, Synergiz, The Nature Conservancy, World Resources Institute, and WWF US. The IUCN consortium comprises the Dutch Committee of IUCN, Ernst and Young (EY), Trucost, the University of Cambridge (Institute of Sustainability Leadership (CISL), True Price, Industrial Ecology Research Services (IERS), and the UNO Food and Agriculture Organisation (FAO).

<sup>18</sup>Available online: <http://www.naturalcapitalproject.org/library/>

<sup>19</sup>“We work to integrate the value nature provides to society into all major decisions. Our ultimate objective is to improve the well-being of all people and nature by motivating greater and more targeted natural capital investments.” Available online: [www.naturalcapitalproject.org](http://www.naturalcapitalproject.org)

but should we necessarily reason in terms of accountability for natural capital (Carl Folke et al. 2011)? Freeing ourselves of this rationale of capital equates to reasoning differently in terms of common heritage and interconnections, and even solidarity. Thinking about the links of human societies with the biosphere, as well as inter-societal links, equates to thinking about coexistence of the whole which is categorized according to “*écumène*,” as described by Berque (1987, 1996). It remains impossible to reconnect human to the biosphere on the basis that the planet belongs to human, as if it were an object, a source of capital. We shall investigate this point in the second part of the present introduction. For the time being, we will concentrate on the notions of connection, of “reconnection” (a) and of “reconciliation” (b), which will lead us on to the notion of harmony (c).

### *How Can We “Reconnect”?*

- Means of “mediation”

Connecting consists in “making contact” or being connected by close relationships. The nerve center of the connection is situated in what generates the link. Connecting leads to creating or recreating links, establishing or re-establishing a link by means of a mediating system. Indeed, the act of connecting or connecting oneself (defined by “*reliance*” in French) requires drivers such as mediators between a person, a group, and a system of which they are a part, or between subsystems (Bolle 2003, 102).<sup>20</sup> The mediating systems involved in this mediation can be: systems of being (identity, sociocultural patterns, sociocognitive representations, behavioral systems); social institutions (institutional systems); practices (ways of working, action systems), habitus (provisional systems for practices, ways of thinking), and standards (endogenous and state regulatory systems).

Normative mediation may be formalized by an “ecological pact” advocated by Nicolas Hulot (2006) and Lester R. Brown (2007). The program of actions embodied in the pact translates a “natural contract” which presupposes a symbiotic and reciprocal relationship (see Serres 1992: 67).

Mediation systems characterize human’s relationship to the biosphere by the paradigms that underpin them, and reflect the values and statuses (subject, object) accorded to the components of the planet. Creating a relationship will depend on the distance established between the human and the nonhuman. The cursor of the distance between the two will depend on cultural conditioning: “each individual is caught up in a particular socio-cultural system that makes him see and understand reality in a certain way, a way which is specific to the society he belongs to” (Berque 1996: 39). The mediation of the link depends on an ethical dimension (values and

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<sup>20</sup>“Social players are both linked (they have direct links among themselves), and connected by one or more mediating systems (whether a social institution or a cultural system of signs or collective representations)” (Bolle 2003: 103).

virtues), a cultural dimension (this relates specifically to the human), and a legal dimension (regulation). The latter originates from the “parasitic” relationship of human toward the biosphere and recognizes the desirable conclusion of a contract of symbiosis and reciprocity.<sup>21</sup>

Reconnecting through mediation constitutes the very challenge of a “socio-ecological” pact, where coviability is defined by an intertwined relationship because of the interconnections that underpin the uniqueness of the whole (human as part of the biosphere). But this uniqueness would almost certainly be accompanied by an intrinsic pact which would be part of the common world or biosphere.

- Internalizing nature rather than externalizing our actions: merging in a common world<sup>22</sup>

The common world defines a “collective” which must neither combine nature and societies nor juxtapose them because the two paralyze each other (nature versus culture). Rather, they should meet and exist together within the biosphere. The composition of this world, the result of a shared and co-constructed history with all living beings, is jointly realized: we are therefore moving away from a subject/object oppositional relationship to a human/nonhuman couple. If the collective means “the whole but not two separated” (Latour 2004, 95), the properties of the couple are interrelated, resulting in defining the anthroposystem as the result of a long biological than biocultural evolution because the human is a part of nature<sup>23</sup> and nature is a part of the human. By transcending the subject/object relationship, we admit that the nonhuman is not an object, and we consequently free ourselves of the anthropomorphic vision of the notion of environment itself. The “biosphere world” therefore does not include objects of nature and human subjects but combines all of the biotic and abiotic elements that constitute the same planet.

- The bind of “usefulness”

Humanity is linked to the biosphere because the latter renders its existence possible. What enables the human species to exist, live, and develop is found in its environment, the biosphere. More than just a simple habitat, the planet Earth defines a “human environment” (Berque 1987) associating the physical, the chemical, the biological, and so forth. This sphere of the human being defines a relationship of usefulness, that is, a means to exist with a view to a given purpose (Barrière 2016; Barrière 2015). Usefulness concerns this aptitude to ensure the viability of humanity.

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<sup>21</sup>“The parasite takes everything and gives nothing. The host gives everything and takes nothing. The law of control and property is reduced to parasitism. Conversely, the law of symbiosis is defined by reciprocity: man has to give back to nature as much as it gives him; nature has become a subject of rights” (Serres 1992: 67).

<sup>22</sup>The unification of realities (Latour 2004).

<sup>23</sup>« Formerly man was a part of nature; now he is the exploiter of nature » (White 1967, 1205).

However, even if the notion of usefulness should not be understood here in economic and utilitarian terms, the notion of “service” is generally understood in these terms because it relates to a political structure aiming to integrate nature into the market logic. In this way, the biosphere complies with human ends. The term “service,” first mentioned in the 1970s<sup>24</sup> for pedagogical reasons, became a key concept in biodiversity protection policies with the Millennium Assessment (2005) and the TEEB initiative (The Economics of Ecosystems and Biodiversity)<sup>25</sup> (TEEB 2010). It is also at the center of the Capital Natural Project (op.cit.), the objective of which is to protect and restore nature by developing payments for ecosystem services.

The ecosystem service is defined by the usefulness of ecological functions for human, and consequently, the expected guarantee that these functions are preserved. This usefulness demonstrates a “need” for the biosphere (natural resources, energy flows, different components such as water, air, and so forth) and the biosphere, which is highly artificial, depends on anthropogenic practices and actions (their presence, type, orientation, intensity, etc). Therefore, usefulness works for both partners, human and biosphere, which actually form one: the biosphere being a whole which is defined within an anthroposystem (see below). Usefulness can therefore be seen as “socioecological”: an obligatory, integrating, or even subservient relationship which reintegrates human into the biosphere.

### ***“Reconciliation”: Building a Socioecological Unity for a Human-Oriented Future***

Re-reaching an understanding consists in envisaging a perpetuation of humanity. Reconciliation initiates a process that looks to re-found the existential paradigm. Initially, it could be a question of “... working toward reconnecting humans to nature (which) could make it possible to give every citizen the feeling of being part of a complex and dynamic living whole” (Fleury and Prevot-Julliard 2012: 11), the biosphere. Because the socioecological entity that we are defining is based on interdependence, it should reconcile humans and nonhumans, but should firstly also achieve a (re)conciliation between humans among themselves.

However, the Western view of human as the “Master of nature” has required the domination of human by human. Technology is in part responsible. Consequently, the technological revolution has permitted this increasing domination of nature by

<sup>24</sup>de Groot 1987 et Westman 1977, cités par Teillac-Deschamps et Clavel, 2012 : 311

<sup>25</sup>“The Economics of Ecosystems and Biodiversity (TEEB) is a global initiative focused on “making nature’s values visible.” Its principal objective is to mainstream the values of biodiversity and ecosystem services into decision-making at all levels. It aims to achieve this goal by following a structured approach to valuation that helps decision-makers recognize the wide range of benefits provided by ecosystems and biodiversity, demonstrate their values in economic terms and, where appropriate, capture those values in decision-making.” Online available: <http://www.teebweb.org>

human while concealing a revolution of power relationships through technicality (Porto-Gonçalves 2006). Capitalism, owing to its invasive character (Santos 1996), extends and intensifies these processes of domination and ecological destruction, but also sociocultural processes in a time when globalization reigns. Re-founding our relationships with nature therefore requires re-founding relationships within and between societies.

This grail of unity reflects the intertwining of human societies in the sphere of life, the biosphere on a global scale. In this case, the stake exceeds the “ecology of reconciliation” (Rosenzweig 2003), which promotes the articulation of human activities to avoid disturbing biodiversity (Fleury and Prévot-Julliard 2012: 11). In this representation, biodiversity is only the human “environment,” not the biosphere.

The passage to a condition of “reconciliation,” links with the nonhuman by this “disconnection,” owing to the passage to the Anthropocene Epoch, dissociates Man from the biosphere by objectivizing the latter. What surrounds Man becomes his “environment.” Within a same habitat of existence between all of the living beings present on the planet Earth, this “disconnection” is consequently formalized by the distance that societies (especially of Western allegiance) set by distinguishing Man from the systemic biosphere: the latter becoming the “environment” or “nature.” As a consequence, the human system is differentiated from the biosphere system via the elements it shares—culture and what is external to it. This results in anthropocentrism which clearly expresses international environmental law, as well as national rights, with some exceptions<sup>26</sup>.

## **Why, Then, Are We Now Discussing a “Reconnection” or Even a “Reconciliation”?**

The 2015 UN Plan of Action for Humanity addresses this issue as part of a desire to “transform our world”: “We are determined to protect the planet from degradation, including through sustainable consumption and production, sustainably managing its natural resources and taking urgent action on climate change, so that it can support the needs of the present and future generations.”<sup>27</sup>

Given the magnitude of climate change and the deterioration of biodiversity, humanity is gradually becoming aware of its uncertain future and of the value of the Planet, its sole habitat: “Man is both a creature and a creator of his environment (. . .) we have reached a time in history when we must orient our

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<sup>26</sup>Such as the Ecuadorian Constitution of September 29th, 2008, art. 71, and the Bolivian Constitution of February 7th, 2009, which recognize a right of nature.

<sup>27</sup>Sustainable Development Program for 2030, Resolution of the General Assembly of the United Nations, September 25th, 2015 Annex: Transforming our world: the 2030 Agenda for sustainable development, Preamble, August 12, 2015 (A/69/L.85), “Draft outcome document of the United Nations summit for the adoption of the post-2015 development agenda.”

actions (...) by thinking more about their repercussions on the environment” (UN World Conference on the environment in Stockholm in 1972). As from 1980, the World Conservation Strategy affirmed that “humanity is putting its survival at risk if it does nothing to safeguard the fertility and productivity of the Earth” (IUCN, UNEP, WWF, 1980). The World Charter of Nature was adopted (resolution 37/7 of the United Nations GA, 1980), affirming that humanity is a part of nature and that life depends on the uninterrupted functioning of natural systems. In 1987 the World Commission on the Environment published a report entitled “Our Common Future” highlighting global interdependence. In June 1992, the Rio de Janeiro Earth Summit recognized the urgent need to significantly modify our production and consumption modes<sup>28</sup> and entrusted the States with the responsibility of adopting a sustainable development model (Principle 8 of the Rio Declaration). In 2012, the Rio + 20 Earth Summit led to developing the idea of “the future we want” (UN Resolution 66/228) by “abandoning unsustainable modes of consumption and production in favor of sustainable modes as well as protecting and managing the natural resources that underlie economic and social development (which) are both the primary objectives and prerequisites of sustainable development.” In 2009, April 22nd was declared International Mother Earth Day (resolution 63/278 of 22 April 2009), but without reference being made to the biosphere.

### ***The Harmony of Human Within the Biosphere (or “Human-Nature” Harmony)***

The aspiration to achieve harmony between human and nature in the biosphere<sup>29</sup> is reiterated<sup>30</sup> in the Resolution of the General Assembly of the United Nations adopted on December 21, 2009 (64/196) and the Resolution on harmony with nature of December 20, 2010 (65/164).<sup>31</sup>

This undefined harmony also generates an ambiguity insofar as, on the one hand, human belongs to nature (Nature Charter 1980, op. cit.), and on the other, anthropocentrism characterizes our relationship to nature (see the first principle of the Rio Declaration, 1992, “human beings are at the center of the concerns of ... sustainable development” op. cit.). Indeed, the Western naturalistic representation clearly divides nature and human beings. The Millennium Ecosystem Assessment (MA 2005) provides a clear demonstration of this separation between nature and

<sup>28</sup>Report of the United Nations Conference on the Environment and Development, Rio de Janeiro, 3–14 June 1992, vol. I, resolutions adopted by the Conference, resolution 1, annex I.

<sup>29</sup>It is always the term “nature” that is used.

<sup>30</sup>Principle 1 of the Rio Declaration states: “Human beings are at the center of sustainable development concerns. They have a right to a healthy and productive life in harmony with nature.”

<sup>31</sup>See also the report of the Secretary-General of the United Nations on harmony with nature, delivered on August 19, 2010 (A / 65/314).



societies by the utilitarian relationship of ecosystems *for* human, as they provide “services” to human (twenty-four of which are identified). The four main services provided by ecosystems (supporting, provisioning, regulating, cultural) contribute toward human well-being in terms of safety, freedom of choice and actions, basic material for a good life, and health and social relations.

To be “in harmony” would consequently equate to linking societies and the rest of the biosphere with the objective of ensuring that they correspond to one another by means of a specific combination of elements connected in a relationship of interdependency. The new United Nations Sustainable Development Program for 2030, which is “human-centered,” aims to “transform our world” to “a world where humanity lives in harmony with nature and where wild fauna and flora and other living species are protected” (UN 2015: 4). Firstly, the human/nature dichotomy clearly resonates with the eighth Millennium Development Goals (MDG 2000, see the UN 2015 report), of which a single objective was directly related to a “sustainable environment” that had to be “ensured.” Secondly, this resonance continues via the 17 Sustainable Development Goals (with 169 targets). Commitment focuses on the human being through eliminating poverty all over the world, but also through “radical changes in the way in which our societies produce and consume goods and services,” giving rise to Goal 12 (“establishing sustainable consumption and production modes through a significant reduction of wastes”).<sup>32</sup> With respect to the climate, we retain the resolution of providing “a decisive response to the threat posed by climate change and environmental degradation” (UN 2015: 9), which is reflected in Objective 13 (“urgent actions to fight climate change and its impacts”). Furthermore, the importance given to the sustainable management of natural resources is justified by economic (promoted growth<sup>33</sup>) and social<sup>34</sup> development, leading to Objectives 6 (“sustainable management of water resources”),<sup>35</sup> 14 (“conserving and sustainably exploiting oceans, seas and marine resources as part of sustainable development”), and 15 (“preserving and

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<sup>32</sup>Particularly “(...) a rational ecological management of chemicals and all wastes throughout their life cycle . . .” (UN 2015, 24).

<sup>33</sup>“Progressively improving, until 2030, the efficiency of the use of the world’s resources, both from a consumption and a production point of view, and ensuring that economic growth no longer leads to environmental degradation (...)” (8.4) (UN 2015, 21). Economic growth is very important for urban development: 54% of the world’s population lives in cities, a figure which will reach 66% by 2050. See UN 2014 Report “Perspectives on the urbanization of the world population,” division of the United Nations population. This is why objective 11.6 focuses on reducing the “negative environmental impact of cities per capita, including by paying particular attention to air quality and namely (municipal) the management of waste” (UN 2015, 24).

<sup>34</sup>“We are therefore committed to ensuring the conservation and the reasonable usage of the seas and oceans, of freshwater resources, forests, mountains and drylands, and to protect biological diversity, ecosystems and wild flora and fauna” (UN 2015, 10).

<sup>35</sup>“By 2030, improve water quality by reducing pollution, eliminate waste dumping, reduce emissions of chemical products and hazardous materials to a minimum, decrease by half the proportion of untreated wastewater and significantly increase, on a global scale, recycling and reuse without posing a hazard to water” (6.3) (ONU 2015, 20).

restoring terrestrial ecosystems, while ensuring their sustainable use, managing forests sustainably, fighting desertification, stopping and reversing the process of land degradation, and stopping the loss of biodiversity”).

Change the world. The recent appeal by the United Nations General Assembly to change the world through these Sustainable Development Goals (SDGs) remains resolutely based on a consumerist rationale, a growing pursuit of human development. Are these “arrangements” of human life on Earth sufficient to limit the impacts of human on the biosphere? Does this UN framework place us within a perspective of the harmony of humankind within the biosphere?

Alongside the SDGs, and to go even further, the ecological challenge lies in the paradigms of the position of the human being in the biosphere.

## **Continuity and Discontinuity Between the Human and Nonhuman: Animism, Totemism, Analogy, and Naturalism**

The place of living beings within the biosphere or the cosmos questions the human/biosphere distribution or a continuity between both of them. A clarification is necessary in order to anchor socioecological coviability, which is based on a systemic dimension.

*Religare*, linking and re-linking human to the cosmos, refers to finding “re-linking” for humanity, a link to the surrounding world (Bolle 2003). The focus is on the relationship and not on the being<sup>36</sup>; the relationship goes beyond the player: “for the survival of humanity, it is necessary for each and every one of us to recognize the need to connect with ourselves, with each other, and with the Earth (- . . .)” (Morin 2004: 248).

Everything is linked owing to the unicity of the world. The term “holism” (Smuts1926) finds its origin in ancient times when Greek medicine approached systems in their globality according to the concept that the whole is superior to the sum of all its parts.

The link between human and the biosphere is both material and mental. It is developed within the paradigm of the place of human within Life and the living world (his way of perceiving and considering the world). Consequently, the anthropological approach requires entering into cultural diversity through mental worlds and sociocognitive systems, in order to be able to understand the manner in which people act, do things, exist, and transmit. The relationship to the invisible, questions of death and existence are wholly part of anthropological sciences (set of sciences that study human from different perspectives<sup>37</sup>). Consequently,

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<sup>36</sup>See for Dessalles JL., Gaucherel C. and Gouyon PH., 2016, “the struggle for existence is not that of beings but the messages that pass through them and of which they are the ephemeral hosts.”

<sup>37</sup>See the French Association of Anthropologists: [http://www.afa.msh-paris.fr/?page\\_id=32](http://www.afa.msh-paris.fr/?page_id=32)

**Table 1** Ontological matrix of the properties of the world’s living beings (Descola 2005)

	Continuity physicality	Discontinuity physicality
Continuity interiority	Totemism	Animism
Discontinuity interiority	Naturalism	Analogism

studying human in society, and especially in his relationships with the whole of the living world he is a part of, the biosphere, cannot overlook the joint existence of metaphysics and its diversified foundations, beliefs (in transcendent powers, in one or more divinities, in spirits . . . ) and acts (ritual practices), “which aim to establish specific relationships between men and other beings or extra-human powers” (Bonte and Izard 1991: 619). The interdependent system of values and practices defines moral, ethical, and religious frameworks, with their paradigms. Because of the lack of associated skills, the religious factor is not included in this work. Our purely scientific approach does not aim to “impose a higher representation of reality, intended to be authoritative, but to open up perceptions to enable them to be seen differently by people” (Auray and Bulle 2014).

As a consequence, we will refer to an approach of nature in anthropology which presents examples of the relationships between humans and nonhumans. Concerning the connection of human to the biosphere, anthropological dualism, the soul and the body, continuity and discontinuity, interiority and physicality within and between humans, plants, and animals all participate in the paradigm of coviability.

Man is distinguished from what is not human on two levels: materiality (carnal, corporeal, organic, physical: “morphological and physiological characteristics that are intrinsic to identity,” Descola 2005: 169), and immateriality (incorporeal<sup>38</sup> and more precisely, “mind, soul or consciousness – intentionality, subjectivity, reflexivity, affects, the ability to signify or to dream,” *ibid.*, 168). The two aspects of the living entity are consequently reflected both by a “physicality,” any material device, including the body, allowing humans to act on the world, and an “interiority,” which is invisible and which manifests itself through its effects (Descola 2005).

Differences in human conceptions of nature are defined in the internal-external relationship which participates in living beings’ manner of existing. We are referring back (Table 1) to the categories of the nature/culture relationship which Philippe Descola (2005) presents in the form of ontologies based on a classification of the physical and/or internal continuity or discontinuity between human and nonhuman entities (see summary in Table 1).

Of the four defined ontological types, only naturalism creates a rupture between human societies and nature (between human and nonhuman). It creates a distinction between the universality of physical laws (and thus the continuity of physicalities)

<sup>38</sup>Which may be practices, representations, expressions, knowledge, and know-how (UNESCO Convention for safeguarding intangible cultural heritage, 17 October 2003).

and the uniqueness of humanity (a discontinuity of internalities because culture is only human)<sup>39</sup>.

Animism expresses a continuity of minds (plants and animals are “disguised humans” owing to the metamorphosis capacity that allows humans to be incorporated into an animal or a plant) with a discontinuity of physical forms (every species has its own physical characteristics—feathers, hair, scales, or bark).

Totemism translates an indistinction between human and nature owing to a resemblance of interiorities and physicalities, an “intimate relationship” between the human and nonhuman.

Analogism defines an ontology in which everything is unique: everything which exists is broken up by “small deviations” resulting in “a dense network of analogies (of correspondence) linking the intrinsic properties of the entities identified” (Descola 2005).

These ontologies stem from forms of aggregation from humans to nonhumans. They participate in the diversity of paradigms that do not authorize the human to be considered in the singular form.

Cultural diversity, especially ways of being, thinking, doing, and the geodiversity<sup>40</sup> of local knowledge, clearly lead to a diversity of paradigms. However, this diversity of human ontologies in their relationships with other beings in the biosphere is confronted with a kind of “technocratic anthropocentrism.” Indeed, this anthropocentrism promotes technical reasoning above human reality because human “no longer possesses the feeling that nature is a valid reference or that it offers him a living refuge. He sees nature without prior assumptions, objectively, in the form of space and matter for a work into which everything is thrown no matter what the result is” (Guardini 1956: 68).

Our era of planetary change is confronted with the globalization of the technocratic paradigm as a deviation from the naturalistic westernization of the world: “life is being abandoned to circumstances conditioned by technique, understood as the primary means of interpreting existence” (Pope Francis 2015,110).

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<sup>39</sup>The debate between Viveiros de Castro and Descola (Latour 2009) deserves to be mentioned here because it problematizes the framework proposed by a Western structuralist anthropology. According to Viveiros de Castro, based on Latour’s account (2009, 2) “perspectivism, in his view, should not be regarded as a simple category within Descola’s typology, but rather as a bomb with the potential to explode the whole implicit philosophy so dominant in most ethnographers interpretations of their material.” Latour continues: “As Viveiros explained, perspectivism has become something of a fashion in Amazonian circles, but this fashion conceals a much more troublesome concept, that of ‘multi-naturalism’. Whereas hard and soft scientists alike agree on the notion that there is only one nature but many cultures, Viveiros wants to push Amazonian thought (which is not, he insists, the *‘pensée sauvage’* that Lévi-Strauss implied, but a fully domesticated and highly elaborated philosophy) to try to see what the whole world would look like if all of its inhabitants had the same culture but many different natures” (Latour 2009, 2).

<sup>40</sup>Geodiversity, according to Grenier (2003, 2014 and in part xx of this book), can be defined as a diversity of geographies or anthropogenic footprints, that is accompanied by cultural diversity (of languages, environments, etc.) and which maintains biological diversity resulting in biocultural diversity.

“Reconnecting” human to the biosphere, in various forms, is the subject of declarations, of objectives set by the international community and philosophical postulates. The incantation to “reconcile Man with all living entities,” which is becoming recurrent in global discourse, is based on the acceptance of a universal responsibility,<sup>41</sup> human being clearly responsible for his impacts on the Planet.

The basis of this acceptance lies not only in ethical, philosophical, or moral convictions, but also in scientific evidence demonstrating the joint and inextricable relationships between the notions of human, nonhuman, and ecology. Socioecological coviability stems from the interdependence of societies and the biosphere. This dependence is reciprocal. There is no doubt that the planet Earth could have done without humans. If this had been the case, it wouldn’t have constituted the living environment of humanity, and the analysis would stop there. Human wouldn’t exist without the Earth and the Earth would have been quite different without this particular inhabitant. The only known habitat in the solar system for humans, planet Earth, is irremediably tied to a humanity that has rapidly transformed it into an anthroposystem. Indeed, the time during which human has been present on Earth is insignificant compared to the planet’s 4.5 billion years of existence.

Socioecological interdependence (human-biosphere) generates this universal paradigm which consists in a mass of links and relationships between living organisms belonging to the biosphere; the objective is to analyze the organization of these links. An interdependency and links on which almost one hundred researchers are working in this book in order to contribute toward the emergence of a concept which defines and provides the basis for this paradigm. It is here, in the scientific world and not in the economic, financial, or political world that a view on the relationship between human and his environment is being developed.

Although the term “environment” is used throughout this book, the scientific analysis is objective and moves away from anthropocentric preconfigurations: there is therefore human, as part of the biosphere, and what surrounds human does not constitute an object but the complement of a unique system to which human belongs. The term “viability” allows neutrality to be maintained, leading to a demonstrative and undemanding analysis. Consequently, there is no “sustainable development” flag being brandished here; but a demonstration, through socioecological “viability,” of a coviability free from duality. Indeed, it is not a question of two elements, a socio-system and a cohabiting ecosystem, but rather of a single matrix of interactions and interconnections within a single system. The difficulty of the approach lies in the fact that the “social” and the “ecological” became increasingly intertwined over the course of evolution. The challenge of this book therefore lies in involving science in the emergence of the paradigm serving as a basis for this socio-ecosystem.

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<sup>41</sup>See Dalai Lama and Stril-Rever, 2016.

## **The Book's Outline: The Emergence of a Concept/Paradigm, the Coviability of Social and Ecological Systems**

The challenge of this first work on the question of coviability is based on the premise of the interrelations between human and his environment. The challenge is to imagine a different relationship to the world, not only leaving behind anthropocentrism and a consumerist rationale, but also ethnocentrism (“of one’s own culture”). The expected result is to objectively consider this relationship by freeing ourselves of the dominant factor of sociocognitive references which are particular to each person. The editors of this book are from three different continents and eleven different disciplines.<sup>42</sup> This is a first step in developing the perspective of the new socioecological coviability paradigm.

Associating the two systems (social and ecological) stems from a naturalistic rationale based on a material continuity between the human and the biosphere, but with culture separating them. Indeed, the latter, according to the West’s naturalist paradigm, provokes a discontinuity which breaks the continuum of the link between human and the biosphere.

However, coviability defines socioecological interdependency by a socioecosystem owing to the interweaving of culture and the biosphere. Interconnection forms a single set which cannot be dissociated owing to the fact that the socioecosystem is defined within the biosphere and not in the interweaving of two worlds whose distinction is based on their opposition. This super-system finds its foundation in a single existence, a single biosphere. Consequently, what is not human in appearance still participates in the anthroposystem. Otherwise, we would have been in a situation of an exo-planet as in the case of Kepler-452b for example (Jenkins et al. 2015), which is free from human beings.

The social system is not an ecosystem, yet the biosphere combines the two because on Planet Earth, one does not exist without the other; and further still, one contributes toward the other. Indeed, if the biosphere system conditions human, we now condition the biosphere (Serres 1992, who uses the term “nature”). This is where coviability lies, a joint viability for a common reality. However, the idea of coviability goes beyond the idea of sharing, which results from the different ontological paradigms of the relationship between human and the biosphere: the “socioecosystem” constitutes a single system.

This book addresses the complexity of the concept coviability by establishing it as a paradigm on the basis of an analysis and related perspectives concerning the relationship between human and the biosphere. From the beginning of the project, the process was collective. Disciplinary departmentation is a leitmotiv that structures the work to permit a more in-depth examination of this complexity. It is not easy to step out of one’s biotope, context, equations, test tubes and lab benches, terrains,

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<sup>42</sup>Environmental law, legal anthropology, bio-ecology, geography, agro-computing, anthropology, computer science, agro-bio-ecology, agro-economics, biology, hydro-geography.

etc. of one's own research topic. Breaking out of one's prism to address fundamental issues on planetary ecology at a regional or local level was a first challenge. The second challenge consisted in a genuine quest for a grail, the coviability of social and ecological systems, repositioning human as a key element of the biosphere, having "the capacity both to destroy and integrate."

This book compiles forty-three chapters of works and experiments, of analyzes and scientific approaches that allow us to take a first step which can be summarized by the definition of contours, the laying of milestones, data clearance. The last chapter of the book reviews the results achieved: the concept of coviability established as a paradigm by the scientific world with a view to providing an alternative approach. The latter opens up another perspective in order to: (a) renew the statutory and regulatory frameworks, thereby avoiding restricting ourselves to a financial rationale (nature as capital); (b) free ourselves of the "sustainable development," obligation which restricts the ontology of the relationship between humankind and the biosphere.

The book develops the possibility of a paradigm shift by mobilizing one hundred or so researchers from a wide range of disciplines (more precisely: law, legal anthropology, economics, sociology, philosophy, mathematics, biology, ecology, botany, agro-bio-ecology, hydrology, computer science, modeling, anthropology, ethno-ecology, geography, electrical engineering, chemistry, oceanography, architecture and urban planning, geomatics, and so forth). It adopts a process of consilience (coordinating disparate results from various sources), based on interdisciplinarity to endeavor to adopt a transdisciplinary profile which imposes deciphering human's actions and relationships in the biosphere. From the foreword, the tone is given with respect to the stake of a new relationship between humanity and its habitat. The preface, written by a distinguished economist from the University of Wisconsin-Madison, highlights the conflict stemming from the contradiction of logics between humanity, which has set itself ultimate objectives and the biosphere, which is positioned in a function logic. A realignment is necessary to permit human's viability in the biosphere.

The introductory chapter clearly sets out the issue: Formalizing a paradigm, the biosphere in the face of the relationship between human and nonhuman. Examples of socioecological coviability facilitate an initial understanding of the contours of the book's contribution. It is structured according to four parts, spread over two volumes,<sup>43</sup> that present three phases: conceptual, applied, and reflexive. From the outset, the need for the conceptualization of the coviability paradigm was clear and its disciplinary bases were scrutinized in order to use them within an interdisciplinary perspective. The first part (in vol.1), *Towards the Theoretical Foundation of Coviability: In Search of Multi-disciplinarity*, is devoted to the foundations of the coviability paradigm.

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<sup>43</sup> Volume 1: *The foundations of a new paradigm*; Volume 2: *Coviability questioned by a diversity of situations*

The conceptual explanation leads on to more empirical analysis includes an “applied” dimension that initially focuses on the governance of coviability by norms, policies, and actors (Part 2, vol.1). The third part (Part 3 integrated in Vol.1) establishes coviability as a challenge for the future. Faced with an ecological emergency, the challenge for humanity consists in taking account of its own complexity, which is deeply rooted in and an integral part of the biosphere. Two chapters summarizing the definition of the purpose of the work. An overview analysis leads us to an ontology of the coviability paradigm. Transdisciplinarity is then used to cover the determinants of the coviability paradigm. Of course, no discipline takes precedence over or imposes itself on the others, as the reader will have guessed from the outset of the work.

To introduce the second volume which is the last part of the book, Edna Maria Ramos Castro, an Amazonian and Brazilian sociologist, highlights the opposition of profit and preservation that forces human society to make choices; choices that necessitate breaks in lifestyles and economic systems, in order to re-establish the link between human, their own nature, and the biosphere. Volume 2 presents a variety of situations that questioned coviability. Two-thirds of the cases studied reveal a need, a search for coviability while existing cases illustrating this paradigm are becoming few and far between.

As the challenge of the book exceeds a single disciplinary field, requiring a multitude of contributions, twelve scientific editors from twelve different disciplines were called on to complete this editorial project. The very paradigm of coviability is, in essence, the product of this alchemy, this transcendence of fields, scientific approaches, and languages.

If the preface stresses the challenge of overcoming the contradiction which opposes Man and the biosphere, the conclusion poses coviability as a categorical imperative in the face of an ecological emergency: a necessary and unconditional action, based on the principle of universality and the “immediate principle of legislation” (Kant 1785).

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For 20 years, his work has focused on the relationship which bond human beings to their environment, within the limits of a legal regulation which is faced with progressing global and environmental changes. He thus works on the local law concerned with the viability of systems by promoting innovative concepts such as “land tenure-environment,” the “coviability of social and ecological systems,” and “negotiated right” which creates a relationship

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The book is led by researchers from several French research institutions, the Research Institute for Development (IRD), the National Centre for Scientific Research (CNRS), the National Research Institute of Science and Technology for Environment and Agriculture (IRSTEA), Brazilian universities (Federal University of Pará and Federal University of Bahia), and the Moroccan Ibn Zuhr University of Agadir.

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**Mohamed Behnassi, PhD** is specialist in Environment and Human Security Law and Politics. After the obtention of his PhD in 2003 from the Faculty of Law, Economics and Social Sciences, Hassan II University of Casablanca for a thesis titled: *Multilateral Environmental Negotiations: Towards a Global Governance for Environment*, he accessed to the Faculty of Law, Economics and Social Sciences, Ibn Zohr University of Agadir, Morocco, as Assistant Professor (2014). In 2011, he obtained the status of Associate Professor and in 2017 the status of Full Professor. He served as the Head of Public Law Department (2014–2015) and the Director of the Research Laboratory for Territorial Governance, Human Security and Sustainability (LAGOS) (2015- present). In addition, Dr. Behnassi is the Founder and Director of the Center for Environment, Human Security and Governance (CERES) (former North-South Center for Social Sciences (NRCS), 2008–2015). Dr. Behnassi is also Associate Researcher at the UMR ESPACE-DEV, Research Institute for Development (IRD), France. In 2011, he completed a US State Department-sponsored Civic Education and Leadership Fellowship (CELF) at the Maxwell School

of Citizenship and Public Affairs, Syracuse University, USA, and in 2014 he obtained a Diploma in Diplomacy and International Environmental Law from the University of Eastern Finland and the United Nations Environment Programme (UNEP), Finland. Dr. Behnassi has pursued several postdoctoral trainings since the completion of his PhD.

His core teaching and expertise areas cover environmental change, human security, sustainability, climate change politics and governance, human rights, CSR, etc. He has published numerous books with international publishers such as *Environmental Change and Human Security in Africa and the Middle East* (Springer 2017); *Vulnerability of Agriculture, Water and Fisheries to Climate Change* (Springer 2014); *Science, Policy and Politics of Modern Agricultural System* (Springer 2014); *Sustainable Food Security in the Era of Local and Global Environmental Change* (Springer 2013), *Global Food Insecurity* (Springer, 2011); *Sustainable Agricultural Development* (Springer, 2011); *Health, Environment and Development* (European University Editions, 2011); and *Climate Change, Energy Crisis and Food Security* (Ottawa University Press, 2011). He has also published numerous research papers and made presentations on these at international conferences. In addition, he has organized many international conferences covering the above research areas in collaboration with national and international organizations and managed many research and expertise projects on behalf of various national and international institutions. Dr. Behnassi is regularly requested to contribute to review and evaluation processes and to provide scientific expertise nationally and internationally. Other professional activities include Social Compliance Auditing and consultancy by monitoring human rights at work and the sustainability of the global supply chain.



**Gilbert David** is a marine and island geographer by training and research director in IRD: UMR Espace-Dev, head of the research team dealing with integrated approaches of nature and society. During his career, he experimented different types of coviability. From 1984 to 1991, he studied the links between reef fisheries and food security of islanders in Vanuatu (South Pacific).

From 1991 to 1996 he was involved in a project dealing with the spatial coviability of New Caledonia. This big island was divided into three parts: an urban center (Noumea), rural areas with nickel mines, and rural peripheries, whose evolution's trajectories were different. How to cope with these differences and how to change these trajectories to reach a viable future for all people of New Caledonia?

From 1997 to 2000, he was involved in the Regional Environment Programme of the Indian Ocean commission (Comoros, Madagascar, Mauritius, Reunion, Seychelles) working on the coral reef action plan in order to cope with the increasing uses of this ecosystem in the Western Indian Ocean region. From 2003 to 2009, he was based in Reunion Island working of integrated coastal zone management (IZCM) and marine protected areas (MPAs), both considered as tools for coviability. After 2 years in Brest, he is now based in Montpellier. IZCM and MPAs are still his main research topics.



**Vincent Douzal** graduated from Institut national agronomique Paris-Grignon (INA-PG, now AgroParisTech) and École Nationale du Génie Rural, des Eaux et des Forêts (ENGREF). He completed masters in robotics and a thesis in computer science, on perception: mathematical modeling and data analysis of descriptive sensory analysis experiments, including the underlying theoretical framework on perception. Then for several years he was head of a team in a regional public administration in Grenoble, France, conducting civil engineering works in water supply and sanitation, rural electric infrastructure,

irrigation, waste incineration plants, waste sorting centers, and public education buildings. He was responsible for the negotiation process leading to the global regional collective planning of waste treatment. He returned to research in a multidisciplinary team spanning from remote sensing to spatial modeling and social implications of using spatial and temporal data for collective decision-making, with the mandate of defining the bases of information systems for scholarly and general issues on natural hazards. His current work focuses on traceability in computer systems, a problem tightly connected to the representation of time in information systems, with many implications on memory preservation and cultural heritage, long-term digital archiving, hypermedia and collaboratory systems, and of course, at the very basis, reproducibility of scientific results.



**Mireille Fargette** graduated at both Université Aix-Marseille III (France), where she obtained a Master in Biology and Ecology, and Ecole Nationale Supérieure d'Agronomie (Montpellier SupAgro, France), where she obtained a Master and a PhD in Agronomy. She has been working for IRD (Institut de Recherche pour le Développement) on scientific questions in tropical Southern countries, through national and international scientific programs. She has worked abroad for part of the time. She has published more than 50 publications in indexed scientific journals and participated (posters or papers) in 68 scientific congresses. She first focused on the plant domain (biology, parasitology, ecology) and biodiversity related to agro-systems. More recently her main interests have encompassed the systemic relationships between societies and their environment (including man and societies relationships, on the one hand, and their links with the environment and “natural systems,” on the other hand). Her main scientific interests (e.g., dynamics and viability of complex systems, Southern territories, scientific observatories) call for an interdisciplinary approach and rely on ontological approaches and symbolic modeling in order to share knowledge and representations.





**Thérèse Libourel** is Professor Emeritus in the Department of Computer Science at the Montpellier University. She participated in the creation of UMR ESPACE-DEV (IRD, UM, UAG, UR) and assured co-direction and direction thereof from January 2011 to September 2014 after having been a member of the Montpellier Laboratory of Informatics, Robotics and Microelectronics (LIRMM/CNRS). She received her PhD from Montpellier University in 1992 and she got an HDR (accreditation to supervise research – standing for “Habilitation à Diriger des Recherches” in French) in January 2003. She has served as a program committee president and member for several conferences in information systems and databases (BDA, INFORSID, CASSINI, SAGEO, ICEIS). She is a member of the GDR Magis (Methods and Applications for Geomatics and Spatial Information). Thérèse Libourel has been studying and teaching information systems, databases, and software engineering for nearly 15 years (in various Master University Montpellier 2 and International Master ICT USTH). Her research interests specifically include complex system modeling in various fields (Biology, Geographic Information System, Robotics), particularly in the area of object modeling paradigm where she gained expertise in a number of key issues such as object methodology, data models, data evolution, metadata, information integration or modeling UML and its evolution. As a result of her strong implication in various projects, she is closely collaborating with different research partners from various disciplines (agriculture, environment, biology, geography, etc.) and consequently gained a significant experience in interdisciplinarity.



**Maud Loireau** is a research engineer at IRD (Institut de Recherche pour le Développement) with a competence in international agro-development (ISTOM engineer) and geography (PhD, University of Paul Valéry – Montpellier 3). She has been working for more than 25 years in arid areas in Saheli and Northern Sahara, and generally in threatened territories (arid zones vs desertification, pioneer frontier vs deforestation and urban extensions, mountains areas changing vs tourism).

Her research consists in constructing, formalizing, and using conceptual frameworks (observatory, landscape, viability, attachment to places) and methods (data collection, co-construction and formalization of shared knowledge, modeling) to characterize the links between the systems involved and their spatiotemporal footprints, between the societies concerned and the place they live in.

This research is conducted on fragile territories and/or in transition under constraints from global changes with management issues, in order to develop ways to observe, analyze, and monitor the dynamics of these territories, and ultimately contribute to enrich and share knowledge, to facilitate discussions and negotiations between actors, accompanying the manager's decisions and actions.

With some 60 scientific publications including book chapters, journal articles, and conference proceedings, her scientific expertise, mainly focused on the issue of desertification, has also contributed to consolidate a network of partners in southern and northern countries; she animates the networks "Scientific Societies-Environments Observatories," and "Relations Between Society-Environment and Ecology: From Knowledge to Action," within the frameworks of MAGIS (<http://gdr-magis.imag.fr>) and of the SFE (<https://www.sfecologie.org>), respectively; she encourages communication between scientists, politicians and civil society as a member of the CSFD (<http://www.csf-desertification.org>).



**Laurence Pascal** is lecturer at the University of Montpellier, co-initiator and the specialty of Master "Tropical Plant Biodiversity" and responsible for license teaching units and master, "Plant Physiology and operation of plants," "Perfume, aromas, and biomolecules of living," "co-evolution and symbiosis," "biological heritage." She participates in the inter-university exchange, as a member of the scientific and administrative councils of the "Pôle Universitaire de Guyane," by supervising numerous training courses, and the creation of thematic school of tropical biodiversity in French Guyana.

As a researcher in the team “biocultural interactions and coevolution” of CNRS in Montpellier since 1995, she has joined the Joint Research Unit “Microorganisms Environment Interactions Plantes” (EMPI/IRD, CIRAD, Montpellier University) to study the tolerance of plants and ecosystems to environmental constraints in a context of global change. Her research is based on an ecological approach to chemistry relationships that plants have with their biotic and abiotic environments around contemporary issues (maintenance of ecosystems, their biodiversity and species communities where chemical communication is paramount). Her research explores the diversity of species interactions, with particular emphasis on their dynamic and scalable operation in response to current environmental changes.



**Catherine Prost** is Associate Professor of the Geography Department at the Institute of Geosciences (Federal University of Bahia, Brazil). She completed a postdoctorate at the Institute of Research for Development (IRD-Montpellier, France). Her core expertise areas cover artisanal fishing, territorial and environmental management, and protected areas. She has published papers in accredited journals and communicated several oral presentations in relevant Brazilian conferences.

In addition, Dr. Prost has organized three conferences: the first, second, and third Seminars about Coastal Spaces, in September 2011, May 2013, and October 2016, respectively, at Salvador, Brazil. Dr. Prost is also a Lead Manager of several research projects such as “Communitarian Management of Natural Resources in the Reserve of Collect Bay of Iguape” and “Environmental Management and Territorial Conflicts in the Baianese Maritime Reserves of Collect” both sponsored by the National Centre of Research.



**Voyner Ravena-Cañete** is an anthropologist, associate professor at Federal University of Pará – UFPA/Brazil, resident at the Institute of Biological Sciences, working both in the Postgraduation Program in Aquatic Ecology and Fishing and Postgraduation Program in Sociology and Anthropology at UFPA. She graduated in History (1991), has a Master’s degree in Anthropology (2000), and PhD in Sustainable Development in the Humid Tropics, at UFPA. She develops research and extension projects regarding especially environmental issues that involve traditional populations at the rural Amazon area. Between 1998 and 2005, she carried out research about Amazon peasantry and their ways of living, focusing kinship as strategy to access and use of natural resources. Between 2006 and 2012, she extended her studies to regional sceneries that involved traditional riverine populations in the Amazon and their specific patterns of pluriactivity. Since 2010, she has been developing studies about fishing populations and their way of living, especially within coastal and estuarine environment.

She presently coordinates the research project “Empowerment, local ethos and natural resources: social cartography as strategy to action planning in RESEX’s saliferous marines in Pará,” funded by UFPA and aiming at traditional fishing populations within the Amazon north coast microregion. She develops research and extension activities in the Mocapajuba extractive reserve, in São Caetano de Odivelas, studying and nurturing the strengthening of the native population’s ethos. She works as a consultant in Anthropology for Amazon traditional populations, especially in the fields of natural resources, memory, reciprocity, sociability, and kinship.



**Frédérique Seyler** is Director of Research at IRD (Institute of Research for Development) and Acting Director of UMR Espace-Dev, specializing in the study of interrelated dynamics of the environment and societies. She has a recognized experience on soil-water relationships in lateritic landscapes of Central Africa and the Amazon, studied from both remote sensing analysis (visible, near infrared, and radar) and field data collection. Her areas of expertise are mainly the spatial variability of soils, spatial hydrology (using radar altimetry). She has coordinated several partnership programs in Africa and South America (Brazil and Colombia) and organized transfer of the methods developed, mainly in the field of remote sensing of water resources. Frédérique Seyler is vice-president of the International Commission for Remote Sensing of the International Association of Hydrological Sciences (IAHS). She has coedited two IAHS books: *Improving Integrated Surface and Groundwater Management and Vulnerable in a Changing World*, and *GRACE, Remote Sensing and Ground-Based Multi-scale Methods in Hydrology*.



**Serge Morand** is an evolutionary ecologist, and his main researches focus on parasites and pathogens and their roles in conservation ecology, public and animal health. He is concerned at the role of biodiversity as risk and insurance for zoonotic emerging infectious diseases. He is conducting projects on the impacts of global changes, including climate change and land use land cover change, on the links between biodiversity and health in Southeast Asia, using wildlife-borne diseases as a model. Dr. Morand is a CNRS (French National Center for Scientific Research) research director. He is actually an Adjunct Professor at Kasetsart University, Faculty of Veterinary Technology, and at Mahidol University, Faculty of Tropical Medicine (Thailand), where he teaches disease ecology. He is the author and coauthor of more than 450 articles and chapters, and author and coeditor of 13 books on these domains, with the last ones in 2017:

- by Routledge EarthScan, *Biodiversity Conservation in Southeast Asia: Challenges in a Changing Environment* (Morand, S., Lajaunie, C., Satrawaha, R., Eds.), a book that provides theoretical overviews and challenges for applied research in living resource management, conservation ecology, health ecology, and conservation planning in Southeast Asia.
- by Elsevier, *Biodiversity and Health Linking Life, Ecosystems and Societies* (Morand, S., Lajaunie, C., Authors), a book that fills the gap between the ecology of health and the concepts supported by international organizations, such as EcoHealth and One Health and demonstrates how ecological sciences, environmental sciences, medical sciences, and social sciences may contribute to improve human health through conserving biodiversity and the services it provides to societies.

# List of Abbreviations and Acronyms

AECM	Agri-environmental-climate measures
AEM	Agri-environmental measure
APP	Areas of permanent preservation
ARC	Avoid-reduce-compensate
AWB	Artificial water bodies
CAP	Common Agricultural Policy
CCD	Colony collapse disorder
CDB	Convention on Biological Diversity
CDM	Clean development mechanism
CEREMADE	Centre for Research in Mathematical Decision
CERES	Center for Research on Environment, Human Security and Governance
CIRAD	Center for International Cooperation in Agricultural Research for Development
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CIVAM	Centres d'Initiatives pour Valoriser l'Agriculture et le Milieu Rural
COP	Conference of Parties
CRPMEME	Regional Committee of Marine Fisheries and Aquaculture
CRU	Climatic research unit
CSR	Corporate social responsibility
CUMA	Coopérative d'Utilisation du Matériel Agricole
EC	Council regulation
EFNCP	European Forum on Nature Conservation and Pastoralism
ENCOP	Environment and conflict project
FAO	Food and Agriculture Organization
FFEM	French Fund for the Global Environment
GAEC	Good agricultural and environmental conditions
GDP	Gross domestic product
GEF	Global environment facility
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit

HDI	Human development index
HMWB	Highly modified water bodies
IBAMA	Brazilian Institute of the Environment and of Renewable Natural Resources
ICMBio	Chico Mendes Institute for the Biodiversity
IEEP	Institute of European Environmental Policy
IFRECOR	French initiative for coral reefs
INDCs	Intended nationally determined contributions
INTC	Intermediate nitrate-trap crops
IOC	Indian Ocean Commission
IPBES	Intergovernmental Scientific and Political Platform on Biodiversity and Ecosystem Services
IPCC	Intergovernmental Panel on Climate Change
IRD	Research Institute for Development
IUCN	International Union for the Conservation of Nature
IUGS	International Union of Geological Sciences
LAGOS	Research Laboratory for Territorial Governance, Human Security and Sustainability
LEK	Local ecological/environmental knowledge
MAB	Man and biosphere
MAE	Mesure agro-environnementale
MDGs	Millennium development goals
MEA	Millennium ecosystem assessment
NAZCA	Non-state actor zone for climate action
NEPAD	New partnership for Africa's development
NRCS	North-South Center for Social Sciences
NRP	Natural regional park
NWCZ	North West Coast Zone
OREMSE	Ontology, coral reefs, mangroves, environmental services
PA	Protected areas
PACIM	Passeurs de cultures, passeurs d'images
PB	Planetary boundary
PMA	Protected marine areas
PPES	Payment for the preservation of eco-systemic services
PPF	Peace Parks Foundation
PRIO	International Peace Research Institute
SDGs	Sustainable development goals
SEBRAE	Serviço Brasileiro de Apoio às pequenas e Micro-Empresas
SES	Social-ecological systems
SNUC	National System of Conservation Units
TEEB	The Economics of Ecosystems and Biodiversity
TEK	Traditional ecological/environmental knowledge
TFCA	Transfrontier conservation area
TKW	Traditional knowledge and wisdom
UFBA	Universidade Federal da Bahia



UFPA	Universidade Federal do Pará
UML	Unified modeling language
UNCTAD	United Nations Trade and Development Conference
UNEP	United Nations Environment Program
UNFCCC	United Nations Framework Convention for Climate Change
UNTB	Unified Neutral Theory of Biodiversity
USAID	United States Agency for International Development
WWF	World Wild Fund for Nature
YCW	Young Christian Workers
ZAT	Temporary artistic zone
ZNIEFF	Faunistic and floristic interest
ZUP	Priority urban area

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