EduBioMed CAPACITY BUILDING FOR EDUCATION AND APPLIED RESEARCH IN MEDITERRANEAN UNESCO'S BIOSPHERE RESERVES

Mediterranean Biosphere Reserves: the nexus for environmental management, education and research

The project eBook





















Capacity Building for Education and Applied Research on Mediterranean UNESCO's Biosphere Reserves

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About Edu-BioMed

The project aims to strengthen, ameliorate and upgrade academic activity at four Moroccan and Lebanese Higher Education Institutions (HEIs) in the context of Mediterranean Biosphere Reserves (BRs), in collaboration and through networking with BRs' stakeholders (citizens, visitors, managers and technicians), public administrations and EU Partners.

Partners:

- Universitat Autònoma de Barcelona, Spain (coordinator)
- <u>Université d'Aix Marseille</u>, France
- <u>American University of Beirut</u>, Lebanon
- Université Saint-Joseph, Lebanon
- Université Cadi Ayyad, Morocco
- Université Mohammed V de Rabat, Morocco
- MAB France, France
- Association for the Protection of Jabal Moussa (APJM), Lebanon
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Mediterranean Biosphere Reserves: the nexus for environmental management, education and research $\,-6\,$

What skills are needed for research and education in Mediterranean biosphere reserves?

Angela Barthes, Catherine Cibien, Bruno Romagny

If scientists' warnings are old (Club of Rome report in 1972 etc), those relating to interactions between climate change and the rapid erosion of biodiversity have become clearer over the last two decades - even going so far as to classify the current situation as the sixth great mass extinction crisis (Thomas and al. 2004). As economist Laurent Eloi (2011) notes:

"Our ecological crises reveal a paradox of knowledge and action: the considerable progress of environmental sciences over the past two decades has brought ever worse news about the state of ecosystems. (...) If, by pointing out areas of uncertainty that are still important, the natural and physical sciences alert us to the reality of ecological crises, they do not provide us with the means with which to transform attitudes and behaviours in human societies, societies that are responsible for global environmental change, behaviours and attitudes which are the only ones capable of changing its course. (...) In more provocative terms, one could say that social sciences and humanities hold the key to the solutions to the problems revealed by hard science. Hence, the two domains need to be articulated if ecology does not want to be reduced to an increasingly exact science of considering disasters.

Protected areas are one of the pillars of national and international nature conservation policies. If they are to be effective, their land area must increase - both for land and marine ecosystems. Their interconnection must also be improved through the adoption of practices that protect "ordinary" biodiversity in human activities. Since the 1990s, various policies described as "sustainable development" have supported measures that formalise the links between the necessary management of biodiversity (Blandin 2009; Rockström et al, 2009) and a local development that should be inclusive and support a reduction in social and territorial inequalities, whilst also being as neutral as possible in terms of greenhouse gas emissions. At territorial level, multi-stakeholder and multi-level governance mechanisms are expected to propose "open-air laboratories" for the environmental transition. Under the recent mechanisms, the importance of scientific approaches integrated with the social needs of development of all globalised territories is systematically recalled, along with the need to articulate specific management methods coordinated with the economic and academic spheres, and lastly the need to increase the mobilisation of citizens in all available educational spheres (Cibien 2006).

Since 1971, the UNESCO *Man and the Biosphere* (MAB) programme, has taken up various organisational principles across the political, scientific and academic spheres within various territories. In theory, the objective is to reconcile regional sustainable development practices with protecting the environment and, more specifically, conserving biodiversity, whilst respecting the cultural values of all. Biosphere reserves are the formal expression of this, and a designation that UNESCO grants to sites considered to be exceptional territorial spaces for experimenting with specific operational methods for intersecting objectives and issues, in connection with education for sustainable development.

Today, the UN's World Network of Biosphere Reserves system supports Agenda 2030 and the 17 Sustainable Development Goals (SDGs). It encourages the development of interdisciplinary research and relies on its worldwide network to disseminate its experiences, approaches and know-how. The different global and local political scales are thus centred around a range of consequences in terms of reconfiguring local political arenas, specific modes of development linked to a renewal of relations to knowledge, powers and institutions, and renewed relations between scientific and educational worlds and territorial governance.

Responding to a multidisciplinary requirement and a dialogue between citizensstakeholders-researchers-teachers, this online project tackles the question of competences between biosphere reserves and sustainable development objectives in the Mediterranean area from the perspective of complexity and multi-referentiality. It was carried out as part of the European Erasmus+ programme Edu-BioMed¹ (2018-22), led by the Autonomous University of Barcelona (UAB). The programme involves five other universities: Aix-Marseille in France, Mohammed-V of Rabat and Cadi Ayyad of Marrakech in Morocco, Saint-Joseph and American of Beirut in Lebanon. It is also established in partnership with several biosphere reserves in France (Mont-Ventoux), Spain (Montseny), Morocco (Arganeraie and Intercontinental Mediterranean Reserve) and Lebanon (Jabal Moussa, Chouf), as well as with the MAB's France network and UNIMED.

This volume² aims to bring together the data collected by the project partners. The contributions thus intend to serve as a basis for reflecting on the research and education skills of Erasmus + Edu-BioMed exchange programme students (2018-22), future managers of Mediterranean biosphere reserves. It responds to the work led by the Conférence des Grandes Ecoles and the Conférence des Présidents d'Université, bringing together higher education representatives and students, as well as employment-training structures, to define a reference framework on the skills that are necessary for sustainable development in higher education.

Sustainable development requires a global approach. To move towards this goal, all five major skills need to be mastered: systemic perspective, prospective outlook, collective approach, responsible approach, and support for change. Sustainable development cannot be approached by a simple succession of skills that are added one after another. On the contrary, skills must be combined and associated using an integrative approach, directly linked to the issues on the ground and knowledge of local actors.

¹ https://www.edubiomed.eu/fr/

² Some of the contributions have been included in scientific reports at a number of conferences and have been selected for inclusion in scientific books.

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PART 1

Legal, organisational, research and educational aspects

What skills are needed for research and education in Mediterranean biosphere reserves? 11

Chapter 1

Man and nature - a history to be rewritten

Magda Bou Dagher Kharrat, Éliane Bou Dagher, Rhéa Kahalé

1.1. Man - a species like any other

There was a time when several human species coexisted on our planet. Just as several species of Equidae¹ currently live side by side, *Homo sapiens* – whose origin dates back 300,000 years according to the latest discoveries at Jabal Irhoud in Morocco (Hublin *et al.* 2017) - lived alongside at least four other human species². These are now all extinct and only *Homo sapiens* remains.

For most of our existence, *Homo sapiens* has been a species like any other. To survive, we gathered plants, fished and hunted and were sometimes hunted by natural predators. We moved to the rhythm of the seasons, following game that, in turn, was following the vegetation which was dependent on changes in the climate.

1.2. Humans exploit and change nature

Only 12,000 years ago, in the area we call the "Fertile Crescent" which today corresponds to Iraq, Syria and Lebanon, the climatic and environmental conditions became favourable to sedentary life. Tired of hunting large beasts that had become rare, *Homo sapiens* began to domesticate plants and animals. On the one hand, we invented agriculture and, on the other, breeding through the domestication of certain species. We started to exploit and store existing genetic resources and modify them by selecting the characteristics that suited us. This same pattern was repeated in several places in our biosphere, a few thousand years apart. This biosphere provided humans with resources that allowed us to develop and colonise almost the entire planet.

As human society developed and the world's population grew, our relationship with nature changed. Agriculture and animal husbandry have given rise to a set of human practices that will destabilise the earth system. These practices have pushed ecosystems to produce more than they are capable of providing spontaneously. And we then changed from being mere "consumers" to greedy and venal exploiters. Along

¹ Horses (equus caballus), donkeys (equus asinus) and zebras (equus quagga).

² Homo neanderthalensis (extinct 28,000 years ago), Denisova Man (extinct 30,000 years ago), Homo floresiensis (extinct 12,000 years ago) and Homo naledi (extinct 30,000 years ago).

with this forced settlement, the sense of private property by possession and the securing of land generated multiple conflicts and wars.

As resources become scarcer, the potential for conflict increases (Homer-Dixon 1999). Since the end of the Second World War, the human population has experienced unprecedented growth. This demographic growth and the increase in consumption levels tend to cause a scarcity of natural resources accessible by each person and, consequently, creates a climate of instability and generates conflicts. When vital resources such as fertile land become scarce as a result of population growth and unequal access to land, impoverished residents will move to ecologically sensitive areas such as hillsides, tropical forests, and areas threatened by desertification.

Population growth in these areas, combined with environmentally unsustainable land use practices, tends to lead to environmental degradation and other forms of deprivation. This phenomenon is known as "ecological marginalisation" (Homer-Dixon 1999). Since the dawn of time, societies have oscillated between damage to the environment and respect for the great laws of ecology.

The world's population, estimated at nearly 2.6 billion in 1950, reached the 7 billion mark in 2011 and will be 9.7 billion by 2050. Since the industrial revolution of 1850, humans have acquired such an influence on the biosphere that we have become its central actor, going so far as to change the face of our planet by our excessive activity. This is indicated by the notion of anthropocene, which etymologically means "the age of man". Humans do not stop overflowing onto territories of wildlife which we discharge of without scruples. With the disruption of ecosystem functioning, forests cleared, soils turned over and mined, species poached... we are increasing the risk of zoonotic diseases and their turning into epidemics or pandemics. In 2016, the United Nations Environment Programme (UNEP) reported that the increase in zoonotic disease outbreaks around the world was a concern. In particular, studies point out that 75% of all emerging infectious diseases in humans are zoonotic diseases closely linked to ecosystem health. This is what we are experiencing today with the Covid-19 crisis.

1.3. The Mediterranean, more than just a sea in the middle of land

The Mediterranean region - with the diversity of its territories located at the crossroads of three continents, its natural and cultural heritage and climate - is severely impacted by human development. It has always been the scene of important environmental and development issues. The economy of this ecoregion is largely dependent on its natural resources. Civilisations and dynasties have succeeded each other, prospering when environmental conditions were favourable and collapsing when resources became scarce.

Our ancestors who populated the Mediterranean basin were creators of biodiversity in the sense that they created new varieties by hybridising and selecting plants. But their age-old actions of exploiting natural resources have changed the face of the Mediterranean forever. This is demonstrated by a recent study in the south of France: even after two millennia of abandonment, the soil of ancient Roman enclosures remains significantly richer in carbon and phosphorus, two elements brought by sheep droppings when they were held in these enclosures (Saatkamp *et al.* 2020). As a result, even 2000 years later, the vegetation is different.

Virtually all ecosystems in the Mediterranean basin are impacted by recent anthropogenic environmental changes. Major drivers of change include climate, population growth, pollution, unsustainable land and sea use practices, and non-native species. In most regions, natural ecosystems and human livelihoods are affected. Because of global and regional trends in regard to these factors, impacts will be exacerbated in the coming decades. This "disruption" of the symbiosis between man and the biosphere has been accentuated by the rural exodus, driven by the hope of finding a better quality of life and jobs in urban areas. The metropolises are populated while the rural areas are impoverished in terms of manpower and previously cultivated lands are abandoned. Rural producers have thus become city dwellers with a consumer profile. It seems that this shift to urban areas is the decisive turning point that led to the dismantling of the connection between the biosphere and humans. Humans that based their mastery of nature on an apprenticeship that has lasted for millennia, is moving away from it and distancing itself from it very quickly.

The requirement to meet the needs of a growing population, in a region with an uncertain climate and looming energy crises, raises many issues: availability and renewal of water resources, soil fertility, survival of forests, natural balances and development of territories, etc. Globalisation has also had an impact on biodiversity and its distribution - a massive impact due to the increased exchange of species, goods and services across borders, a mixing of various practices that disregard national and cultural borders. Human introduction (voluntary or accidental) of exotic species threatens ecosystems, habitats or native species with negative ecological, economic or health consequences. Invasive species have made their appearance and we observe an increasing acceptance of the fauna and flora.

The UN's 2000 Millennium Ecosystems Assessment identified seventeen categories of ecological services that biodiversity provides to humans and highlighted the seriousness of the challenges of maintaining biodiversity in the world's ecosystems. Political awareness of the need to preserve our biosphere has increased, and the MAB programme invites researchers and stakeholders to re-teach humans to cohabit with their environment. In theory, the objective is to reconcile regional sustainable development practices with protecting the environment and, more specifically, conserving biodiversity, whilst respecting the cultural values of all. A feedback involving the reabsorption of individuals who leave urban settings due to suffering the effects of pollution and move to the country in search of green spaces. Biosphere reserves are therefore considered to be special territorial areas for experimenting with operating methods that are specific to cross-cutting objectives and issues.

In order to make humanity sustainable, it is essential that we change our way of life. However, this type of transformation needs to be accompanied by population policies - such as increased education and empowerment of women and family planning measures. The positive nuance is that scientific advances and technology can greatly assist us in our quest to restore these altered links between humans and the biosphere.

1.4. The academic sphere and action to support biodiversity

The academic realm plays a pivotal role at this stage. The expansion of knowledge in the sphere of living organisms and the increase in terms of threats to biodiversity the source of this knowledge - mean that this field of research should be a priority. The new perspectives arising from the scientific advances of the last quarter century concern the three main areas of biodiversity exploration: the continued identification of new species; the advancement of knowledge on genetic diversity as well as functional and genome diversity; and the determination of interrelationships between species within ecosystems.

Biosphere reserves would be living laboratories in which such research can be launched and optimised before being applied on a larger scale. The approach followed will be bottom-up: we will start with local knowledge which is so precious and is being lost very quickly, and upon which we will base ourselves in order to develop appropriate management methods taking into account the specificities of each living community (humans included). The contributions of science and technology to sustainable development will be harnessed. The diversity and adaptability of living beings not only provide chemical molecules to be used in our pharmacopoeia but also offer us biological solutions that are much more sophisticated than human artifacts in responding to selection pressures. This will significantly reduce the use and therefore the impact of the raw material-intensive and energy-intensive industrial processes we employ.

According to a French Senate report on the contributions of science and technology to sustainable development, "the memory of success" that constitutes the biodiversity of living organisms should lead to a rise in biology and biotechnologybased industries which, when joined with the rise of nanotechnologies, will be one of the mainsprings of the next industrial revolution. Two major scientific and technological projects will contribute to this: bio-inspiration and biotechnologies (Laffite and Saunier 2007). And this is where the academic field, as part of an interdisciplinary approach between different curricula, can contribute to meeting these challenges. The knowledge accumulated by the social sciences will then be explored and studied by physicists, biologists or chemists, and put into practice by engineers.

1.5. Biosphere Reserves and Sustainable Development Goals

The 2030 Agenda for Sustainable Development and its associated Sustainable Development Goals (SDGs) were defined as a successor to the Millennium Development Goals and were adopted in 2015 by the international community. Biosphere reserves, with their three-zone design, are an excellent example of how alternative human practices can create a harmonious relationship between people and nature, enhancing the contribution of natural resources and biodiversity to humanity. Biosphere reserves are considered "natural gene banks" that conserve the genetic diversity of plant and animal species, while preserving a healthy ecosystem and natural landscape. The importance of biosphere reserves could be highlighted by understanding how the majority of SDGs could be linked to this type of protected area. The first three SDGs, relating to eradicating poverty, eliminating hunger, achieving food security, improving nutrition and promoting sustainable agriculture,

and promoting good health and well-being are directly related to protecting natural habitats. These contain the bulk of the natural resources that provide a guarantee to local communities against famine, scarcity or poverty, and play a vital role in sustaining livelihoods and well-being. Plant diversity - including crop ancestor plants and traditional varieties found in undisturbed areas such as biosphere reserves - provides the majority of riparian food needs, as well as a wide range of other crops and cultivated resources (Sharrock et Jackson 2017).

It is well known that many plants are used either directly as medicines or as the basis for medicines. In fact, it is estimated that one in eight plants (around 45-50,000 species) has a medicinal use. According to the UN Comtrade³ database, in 2012 global exports of plants whose use was primarily pharmaceutical were valued at US\$2.2 billion, while in 2000, global sales of plant-based products were valued at US\$60 billion.

Environmental education and education on conservation, ecological restoration and sustainable development are key activities for many organisations involved in plant conservation. SDG 4, and in particular target 4.7, is relevant to biosphere reserves. By 2030, the goal is to ensure that all students acquire the knowledge and skills necessary to promote sustainable development, including education for sustainable development and lifestyles, human rights gender equality, promotion of a culture of peace and non-violence, global citizenship, and appreciation of cultural diversity and the contribution of culture to sustainable development (Sharrock et Jackson 2017).

Target 6.5 of SDG 6 calls for the protection and restoration of water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes. Biosphere reserves are ideal places in which restoration techniques that combine phytoremediation, new remediation technologies and new approaches to waste management can be tested before being applied on a large scale. The same is true for clean energy, which should benefit from advances in our technologies to improve access to non-polluting and safe fuels for cooking, increase the use of renewable energy beyond the electricity industry without exerting natural resources (Sharrock et Jackson 2017).

SDGs 8, 11, 12, 13, 14 and 15 are all about re-establishing this sacred link between man and nature, and here again, biosphere reserves are very good open-air laboratories where a partnership with higher education institutions could only be beneficial for each of them. In this respect, the Edu-BioMed project was an unparalleled opportunity to take the plunge and forge links between some biosphere reserves and some higher education institutions.

1.6. References

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Chapter 2

Representations by future biosphere reserve managers in France, Morocco and Spain?

Angela Barthes, Bruno Romagny, Jean-Marc Lange, Mohammed Aderghal, Houcine Amzil, Roser Maneja, Véronique Chalando

1.7. Introduction: Erasmus+ programme and student social representations

This contribution explores the social representations of students mobilised under the Erasmus+ Edu-BioMed programme, the specific objective of which is to propose a training curriculum for potential future biosphere reserve managers. This programme therefore aims to bring together different types of Mediterranean Basinbased knowledge (scientific, management, etc) regarding this type of space by addressing culturally very different students that come from varied disciplinary backgrounds. This sharing of knowledge and know-how from experience gained over time in different contexts by different categories of stakeholders is considered central to improving the governance and public participation processes that are experienced in these areas (Beuret 2011).

We hypothesise that better prior, shared knowledge of the stakeholders concerned, in order to reach a shared perspective of the future of a territory, for example, encourages the proper functioning of knowledge dissemination and project coconstruction mechanisms implemented in the field. This is claimed by some social science approaches - such as the heritage approach - which look at the relationship between society and nature (Cormier-Salem 2014). These heritage approaches (Montgolfier and Natali 1987; Babin *et al.* 2002; Petit et Romagny 2009; etc.) consider that the difficulties that emerge when managing natural resources are primarily problems regarding relationships between humans in relation to nature; they can therefore be approached from the perspective of coordination and collective action. For proponents of the heritage approach, it is mainly the lack of communication that causes situations of environmental conflict. The discussion should make it possible to "render null and void a good part of the conflicts and [...] to displace those that persist" (Weber 1996).

Here, we present an initial structural analysis of social representations in relation to biosphere reserves. This analysis was carried out based on a questionnaire submitted to master's students from different Edu-BioMed programme partner universities in Morocco, Spain and France. These connections are the result of the process of setting up the programme and, as a result, disciplinary coherence has not been questioned in curricular construction¹. The students surveyed therefore come from different master's programmes, being more closely affiliated with geography at the University of Rabat, ecology at the University of Barcelona, and life and earth sciences (LES) for teacher preparation at the University of Montpellier. This multicultural and multidisciplinary panel of respondents allows us to identify, in a highly schematic way, notable similarities and differences in the social representations of these students, in relation to the various national contexts.

We focus our analysis from a perspective of critical scientific education, paying particular attention to a reflexive look at the utilitarian ideology that would dominate our relationship with the world - especially where the initiatives come from European funding. In this light, Bader (2011) notes that critical theory "denounces in particular the use of instrumental rationality that relies on a certain conception of science, locked in a positivist paradigm, and favours the use of technology as the source of the solution [to environmental problems]" (Bader 2005). Citing Roottom and Hart (1993), Fortin-Débart and Girault (2009) remind us that this critical questioning of reality and this commitment to action are more effective when they are done collectively rather than individually. In this citizen's perspective, critical education would then be an "education in power (Audigier 2006) which aims to provide skills to participate in city life (public life, political life, daily life)" (Fortin-Débart and Girault 2009).

After presenting a few theoretical elements that will enable us better to understand the notion of social representations and their usefulness in a cross-curricular approach, this chapter then presents the methodological elements used to analyse the social representations of several groups of students on the subject of biosphere reserves. On the basis of the results obtained, in a final section we propose certain elements for discussion and debate on the role of this analysis of social representations in the framework of a European curriculum development programme such as Edu-BioMed.

1.8. Social representations as a method of exploring students' prior knowledge

Knowledge of any kind exists only because it is socially constituted. However, it transcends the individuals or groups that produce, use, and circulate it and this distinguishes it from knowledge attached to an individual or group of individuals (Lange and Barthes 2017).

The social representations approach makes it possible to develop prior knowledge and takes into consideration the role of the socio-cultural and historical context when constructing and sharing representations (Abric 1994; Jodelet 1989; Moscovici 1961; Wagner 1994). It can be argued that, whilst there is an institutional and accepted definition of biosphere reserves, this area of study remains complex and, in practice,

¹ This adjective refers to that which relates to the curriculum - a Latin term that translates the notion of school curriculum and more broadly the set of educational practices. This term was coined by the American educator Ralph W. Tyler in his 1949 book Principles of *Curriculum and Instruction*. The word then passed through Canadian French and appeared in France around 2014 as part of the reform of school programmes. Source : https://fr.wiktionary.org/wiki/curriculaire.

value-laden and subject to diverse interpretations. The latter must be made explicit by the different stakeholders who support them in order to be able to fully invest in the forms of co-management that are generally proposed by biosphere reserves (Cibien 2006; Bouamrane 2007).

The act of representation is traditionally defined as "a presentation of something to someone's mind" (Bonardi and Roussiau 1999), and is considered to be a true mode of understanding reality. Indeed, it is the process of internalising an object by a subject or a group to become an object of thought, the content of which is substituted for reality. However, this reconstruction by the subject remains indissociable from individual and/or collective history, the social and ideological context. Representation is therefore always social insofar as the act of representation allows for the integration of the objective characteristics of the represented object, the specificities of the subject or group, and the elements of its normative context. Social representations are therefore a powerful tool for analysing the normative systems of a group at a given time.

Social representations are also defined as a "functional vision of the world" (Abric 1994) in the sense that by giving the individual or group an intelligible reading of the complex world, they allow them to be positioned in relation to the normative system, and thus to construct their own reference system. This positioning is part of three interdependent processes: (i) interpretation and thus reconstruction of reality, (ii) communication with the group, and (iii) mastering a code of conduct in the environment.

Social representations ensure a communication function between individuals in the sense that they allow them to develop a common code - called the "normative framework" here - to name and classify their knowledge and their interpretations of the world in the most univocal way possible. This normative framework is also a guide for action insofar as, by communicating, it makes it possible to interpret daily reality, to decide on its various aspects, to position oneself and, if necessary, to make decisions about them (Jodelet 1989).

From then on, the practical aim of social representations and the control of the environment become real issues. Social representations are thus defined as "a form of knowledge that is socially developed and shared, practical in aim and contributing to the construction of a reality that is common to a social group" (Jodelet 1989). This form of knowledge - frequently referred to as *natural knowledge* in educational science (Barthes and Alpe 2016), - is therefore directly related to the behavioural forms adopted by the group or individual (Barthes *et al.* 2015).

1.9. How to study social representations?

Studying a social representation and understanding its functioning entails studying its content and structure. Indeed, Abric (1994) explains that all representations are organised around the central core, without which there can be no true representation and which gives it its meaning and coherence. The central core provides structure and a status of evidence for the group or the individual whilst being a stable element. The notion of core also refers to the identification of individuals with a social group, considering that it provides an assurance of its homogeneity. The core is thus determined not only by the nature of the represented object, but also by the relationship that the subject or group has with it, and finally by the system of values and norms that define the ideological context (Abric 1994). It is therefore the identification of the central core that allows the comparative study of the representations. Peripheral elements are organised around this core. These enable concrete, understandable and transmissible new information to be produced from a given and contextualised situation.

The peripheral elements are organised around the central core. When they are close to the central core, they play an essential role in concretising the meaning of the representation. Beyond that, they illustrate or justify this meaning. The peripheral elements are the most accessible set of social representations, because they are less stable and more alive. In concrete terms, the new information is created above all from the peripheral elements. They constitute a "set of judgments made about the represented object and its environment, stereotypes, beliefs" (Abric 1994). They have an essential role, and this role is going to be largely put forward in the link between social representations and education for sustainable development because their role is to be an "interface between the central core and the concrete situation in which the representation is drawn up or functions" (Abric 1994).

The peripheral elements are directly dependent on the context and result from anchoring the representation in reality. Faced with the stability of the central core, they are the moving and evolving dimension of the representation. However, they also ensure a defence function for the central core, which Flament (1987) calls the *shock absorber* - insofar as it is by modifying its periphery that the transformation of a social representation will take place, as part of a potential second stage. Claude Flament considers that the peripheral elements are *schemas*, organised by the central nucleus, "instantaneously ensuring the functioning of the representation as a grid for deciphering a situation". They are prescribers of behaviours, and instant guides of reactions to a specific situation by designating what it is normal to do or say in a particular situation. In this way, they also help guide instantaneously the reactions or actions of the subjects, without the need for recourse to central meanings. They therefore constitute a personalised modulation of the central cores, more widely drawn up socially and shared.

The social representations are therefore a double system made up of by the central core and the peripheral elements: the central core relates to the historical, sociological and ideological context. It is strongly marked by the collective memory of the group. It defines the group's normative framework. Associated with values and norms, it defines the fundamental elements around which consensual representations are built, relatively independent of immediate contexts. Thus, "the central system is stable, coherent, consensual and historically marked" (Abric 1994). The peripheral system is more individualised and contextualised - that is, more related to individual characteristics and the immediate environment. In contrast to the central system, which is essentially normative, the peripheral system is primarily functional. It is flexible and can incorporate individual variations related to the subjects' own histories, personal experiences and life experiences. This function thus properly ensures the possibility of drawing up individualised social representations, organised nevertheless around a common central core. "The peripheral system is therefore the indispensable

complement of the central system on which it depends. The functioning of the core can only be understood in continuous dialectic with the periphery" (Flament 1994).

1.10. Corpus and methods

In order to carry out this study of social representations of biosphere reserves, we chose the quantitative approach developed by Pierre Vergès (1994, 2001) because of its reproducibility, which makes comparisons possible. The data used here are the answers provided to a spontaneous-mention questionnaire proposed for three groups of master's students in France, Spain and Morocco. The survey population was made up of 41 students enrolled in Morocco, 38 in France, and 39 in Spain, giving a total of 118 students aged 23 to 27. This sample is not representative in the statistical sense. Nevertheless, it allows us to identify certain trends in the population studied. The primary question² students were asked was the following: "What words³ or phrases spontaneously come to mind when you think of biosphere reserves?"

Two preliminary steps were necessary to analyse the students' responses to this question. First, we categorised the elements mentioned by the interviewees according to their lexical proximity. Two indicators were then taken into account: the frequency with which the terms appeared in the responses of the surveyed population and the co-occurrences (number of links) of terms between them. It is the intersection of these two indicators that enables us to offer a graphic representation. With the organisational graph (Barthes and Alpe 2016), it is possible to approach more precisely the notion of knowledge organisation, allowing us to act on it more easily if we wish to modify such social representations. This operation consists of building a notional network in graphic form. This means establishing relationships between the different items by analysing similarities (Degenne and Vergès 1973; Vergès and Flament 1997). The approach classically proposed is to spontaneously classify items by the respondents.

Moreover, the problem of recoding terms - that is, grouping them together - is a methodological point that requires particular attention. Recoding is often necessary, if only initially to group together similar spellings of the answers provided. The most reliable method is direct analysis, which consists of constructing tables of co-occurrences from spontaneous responses, without recoding. But this technique is often impossible to implement, as the answers obtained can be very similar. The method we used is still discussed in the research community and is not always unanimously accepted. It is therefore necessary to keep a critical eye on what we do at this level: not to forget the different recodings; to be open to creating several types of recodings depending on the study objectives; and to keep in mind the limits of these different techniques. This graphical approach is based on the hypothesis that the sum of co-occurrences on a sufficient number of individuals indicates the permanence of meaningful links in the representative object.

 $^{^2}$ We were interested in the mentions generated by other notions such as heritage and biodiversity, for example. However, in this text, we chose to focus solely on the notion of Biosphere Reserve, which is at the heart of the Edu-BioMed programme's concerns.

³ Respondents were asked to give a minimum of 5 and a maximum of 10 words or phrases.

Remember that manual, automatic or semi-automatic methods can be used to conduct this type of analysis. Manual methods consist of placing the set of words on the x-axis and y-axis in a spreadsheet and then recording the number of co-occurrences at the intersection of the words. For example, if Individual 1 cited the term X, Y, and Z in a spontaneous-mention question; Individual 2 cited the terms X, Y, and W; and Individual 3 cited the terms X, Y, Z, and U, then the response table is as follows (table 3.1) :

	Х	Y	Z	W	U
X	0	3	2	1	1
Y	3	0	2	1	1
Z	2	2	0	0	1
W	1	1	0	0	0
U	1	1	1	0	0

 Table 3.1. Example of constructing a co-occurrence table.

This table reads as follows: there are three co-occurrences between the term X and Y - ie three respondents who answered X also answered Y. There are no co-occurrences between the term W and U - ie none of the respondents who answered U also answered W. While graphical processing can be done by hand, most standard software on the market offers automatic data processing. We used the Modalisa software (Kynos).

The graphical results are presented in the form of networks of linked words. They form an image of the notional network of social representation. Words that are very strongly interconnected and frequently cited are presumed to be part of the central core. The closer items are connected to it and the more strongly weighted, the closer and more important the periphery is in interpreting the social representations. To comment on a graph of social representations, it is first necessary to define the central core and the various peripheries, before making the signifiers explicit. The organisational graph provides additional information regarding the proximity of the links between the items and between the central core and its peripheries.

1.11. Results

The following three figures summarise the main results from our analysis for each group of students surveyed.





Figure 3.1. Mentions by students on the "Teacher Training, LES Option" master's course (France)



Figure 3.2. Mentions by students on the "Ecology" master's course



Figure 3.3. Mentions by students on the "Geography" master's course

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1.12. Differences and similarities in social representations across different groups of master's students

1.12.1. Social representations shared by students enrolled in France and Spain

From a comparative perspective, the analysis of the differences and similarities across the three national contexts reveals a relative agreement between master's students in Spain and France. An examination of the responses for these two groups therefore leads to a hypothesis that there is a social representation that is relatively shared - especially given that the reference disciplines are not too far apart. Social representations essentially seem to be structured around nature as the anchor of the Biosphere Reserve concept, associated with the preservation/conservation/protection of biodiversity, species and habitats. The only difference observed in the central core concerns the category "Fauna, flora, animals, species and habitats", which is found among students enrolled in France but more so in the periphery among students in Spain.

This notion of nature, in relation to biospheres and their protection, therefore seems to constitute the central core of a possible representation. The peripheries are somewhat different, being more factual for students enrolled in France and more functional for those enrolled in Spain. In the first case, relatively close to the central core, appear the notions of reserves and conservation areas, of wealth and resources, of human-environment interactions with variations relating to controls, laws, regulations, compensations, etc. Among the mentions made by the group of students in France, we note that there are disciplines such as LES, biology and ecology, which are important factors to be linked in all likelihood to the mentions in terms of cycles, dynamics and space-time. For the group in Spain, the immediate peripheries are more functional and revolve around international relations, the regulation of human action, ecosystem services, rhetoric about sustainable development (extinction risk, sustainability and so on). There is an interesting mention of heritage and culture. Environmental education, on the other hand, receives very little attention.

1.12.2. Strongly varying results for students registered in Morocco

Analysis of mentions by the group of students enrolled in Morocco provides strongly different results from the others. First, these results are richer and the words used are more interconnected. The central core is more complete, and reveals a more systemic perspective of the social representation of a Biosphere Reserve. In the central core, anchoring of nature also features strongly, as does biodiversity, combined with its preservation/conservation. But other aspects make up this central core. Thus, resources and raw materials, enhanced appreciation of species, environment, ecosystems as well as land, life, water systems are additional aspects that complete this group of students' core.

The issue of water and water reserves is widely mentioned in the immediate periphery, indicating that the Biosphere Reserve is linked to the issues related to natural environments (coasts, seas, deforestation, etc) and to a global perspective of human impact in connection with development. The practical question of professional organisations that gravitate around biosphere reserves also appears in a good position, in relation to the problems of planning and cohabitation.

However, the most striking fact for this group of students is their understanding of the Biosphere Reserve issue on a broader scale, as part of a logic that could be described as systemic. It should be noted that, here, the reference discipline is geography, and this could also explain this result. Indeed, the question of scales is clearly posed, with mention made of international (UNESCO among others) as well as national levels (arganeraie, oasis and so on). In general, students enrolled in France seem to have greater difficulty citing specific examples of biosphere reserves at national level than those enrolled in Morocco, who, conversely, are able to do so fairly systematically and relatively extensively.

A final highlight for this group of students is the explicit mention of direct applications to sustainable development and issues of ecological transition (climate, food and so on). Biosphere reserves are therefore well understood in this global environment, in direct relation to the challenges of promoting local products and heritage (tangible and intangible) through alternative tourism activities (rural tourism, eco-tourism and so on).

1.13. Addressing complexity versus a focus on the environment

Analysis of the results from this study of social representations about biosphere reserves reveals a number of tensions.

The first seems to refer to the difference in the level of complexity of the issues surrounding biosphere reserves among the three groups of students surveyed. This complexity features strongly among students enrolled in Morocco, who are intended to be the recipients of the curricular developments (Forquin 2008) piloted by the French and Spanish teams under the Edu-BioMed programme. Clearly, as part of the Edu-BioMed programme, the Spanish and French should offer Moroccans a training programme. In contrast, students enrolled in France and Spain seem to have a much more simplified prior view of this notion of complexity.

Addressing the collective organisation of society, systemic and sustainability positions around biosphere reserves would remove the barrier to critical thinking, especially if it comes from those who are supposed to be developing the curricula. We hypothesise that this would also tend to raise and minimise the issue of the domination of values that Europe spreads to recipient countries. The social representation of biosphere reserves in the three groups studied indicates a very strong focus and corroborates the results already obtained previously in France in regard to sustainable development issues (Barthes 2011). The focus on nature and biodiversity, particularly among students enrolled in Spain and France, may limit their understanding of the complexity of the political, cultural and social processes at play around biosphere reserves. In the face of these social representations, which are strongly focused on nature, we can say that there is a great risk of understanding the biosphere reserve without recognising all its complexity and its multiple socio-ecological dimensions.

Based on analysis of the focus of social representations, the absence of political, economic and institutional issues in the central core of the representation (especially

among students enrolled in France and Spain) confirms the fragmented nature that prevents the complexity of the concepts taught from being grasped. The economic aspects are mentioned by students in France and Morocco, but only in peripheral elements and in very limited terms of resources in the first case, and enhanced appreciation in the second. The notion of compensation is mentioned by students enrolled in Spain. These elements are therefore not organising elements of the representation, whereas they are central components of biosphere reserves. While students in Spain and France take little account of the role of political and institutional bodies in promoting sustainable development, students in Morocco seem to be more aware of this dimension, especially when they mention elements of international cooperation.

Lastly, in regard to the analysis, none of the groups of students envisage any form of political/civic action - either in their social life or future professional life.

We feel it is important to point out that there is a clear lack of debate about the potentially controversial nature of the Biosphere Reserve concept. The representations of the three groups of students seem to show that they do not consider the critical dimensions, alternative models, or elements of complexity that are characteristic of biosphere reserves. In addition, the focus on nature is centred on a truncated representation of the Biosphere Reserve, especially among students enrolled in Spain and France. Moreover, students' references to resources and modes of development confirm a perspective of sustainable development policies centred on a reductive vision of the environment, relating only to resources at the service of human beings. The critical approach to education should make it possible to question this utilitarian vision, at the risk otherwise of an ideological use of the educational discourse to "support a certain vision of the world" (Astolfi 2006).

1.14. Addressing the collective organisation of society versus the use of individual action

There is however a differentiation with the corpus of students enrolled in Morocco, whose social representations constitute a less marked and more nuanced obstacle to critical education than those of students in France and Spain. Indeed, the elements of focus do not refer to the same dimensions.

This element of behavioural focus is an additional obstacle and does not enable us to distance ourselves from reality. The question then arises as to whether, even in the university, teaching is not sometimes a "morality course" prioritising political correctness to the detriment of knowledge (Legardez 2006).

In fact, this prevalence of individual action and responsibility, found in the second periphery, does not raise the issue of collective and systemic organisation of society and raises the question of not distancing teaching from local social practices (Alpe 2006), representing an obstacle to a critical perspective in teaching about sustainable development. Indeed, as part of a critical approach to education, it is necessary to go beyond the level of local and individual action. This type of focus-obstacle is not found among students enrolled in Morocco whose social representations are more oriented towards the collective organisation of society, and less towards a problem to be addressed.

1.15. Conclusion

In light of the proposed approach and our results, two key conclusions can be drawn. First, we can hypothesise that there are significantly different emerging social representations of the Biosphere Reserve depending on the socio-cultural and political context on the one hand, and the disciplinary context on the other. In terms of the differences between the corpora, we were able to identify a focus on the "natural" aspects among students in Spain and France, on the one hand; and a focus on the social and international cooperation aspects among students in Morocco, on the other. However, in the three national corpora, the social representation of biosphere reserves is highly focused and strongly fragmented. These characteristics may prevent an overall vision of the object as well as setting the elements of the representation into a system, thus of its complexity. The representational elements are important and specific socio-educational aspects that should be taken into account when engaging university courses in the implementation of teaching about biosphere reserves. Beyond this, the stakes for society are high and reflect the European Union's commitment to sustainable development as one of its fundamental and core objectives.

Thus, to avoid the risk of training only managers working for governing bodies, whatever they may be, and in accordance with the objectives of *training critical citizens*, it seems essential that teaching should attempt to enrich student representation by incorporating complex elements, their mutual interrelations and associated issues, in what would then be a new "system of representation and knowledge" (Legardez 2004). Indeed, one can consider that the role of education in general and of higher education institutions in particular is not only to provide students with a certain threshold of employability (Adomssent 2006), but should go beyond that and contribute to the formation of knowledgeable and critical citizens.

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Chapter 3

Challenges and opportunities of collaborative research on Biosphere Reserves in the Mediterranean

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1.17. Introduction

The Mediterranean basin, a dynamic region with asymmetries between its northern and southern shores, diverse economic, political, and cultural systems, and numerous sub-regional conflicts includes 136 biosphere reserves (Olson & Olson 2013; Escribano 2000). Collaborative research across the Mediterranean focusing on these biosphere reserves is hampered by a lack of a common language and working styles that do not seem to be alleviated by increasingly sophisticated cyber infrastructure (Stuart *et al.* 2018). Furthermore, researchers in the Mediterranean face problems common in many parts of the world, such as the lack of quick and simple tools for efficient data sharing, as well as limited information, and resources. Even globally accessible tools require time and information not readily available to researchers attempting to store, publish, and share data (Stuart *et al.* 2018). The aim of this chapter is to present global challenges and regional particularities of the Mediterranean that may impede collaborative research on Biosphere Reserves in the region.

1.18. Collaborative research

Researchers have formed and joined collaborative research groups and communities to address complex issues and to mitigate knowledge gaps by sharing competencies and resources, by pooling expertise, by participating in knowledge coproduction, and by engaging in multidisciplinary research which allows for more transparency and less secrecy (McCormick *et al.* 2016; Rycroft-Malone *et al.* 2016; Meleis 2000). The nature and scope of collaborative research may be assessed through qualitative or quantitative approaches which analyze indicators such as the coauthors' professions, institutional affiliations, the organizational level of the collaboration, the authors' disciplinary focus, and/or the authors' geographical focus (Sonnenwald 2007; Lovasz-Bukvova 2010; Amabile *et al.* 2001; Hu & Racherla 2008). Although not all fields lend themselves to collaborative research, the number of peer-reviewed publications with multiple co-authors is on the rise with twice as Mediterranean Biosphere Reserves: the nexus for environmental management, education and research 32

many publications reported in 2015 (21.3 %) than in 2000 (10.7 %) (Koporc, 2018; Øye *et al.* 2019; Qin *et al.* 1997; Ribeiro *et al.* 2017). The number of countries participating in these collaborative networks is also reportedly increased from 174 in 2000 to 200 in 2015, although the level of collaboration varies from one country to another (Wagner & Leydesdorff 2008).

1.19. Beneficial aspects of collaborative research

Researchers have worked together in collaborative groups for tens of years, this trend has become mainstream with increased research complexity and costs to deliver unique knowledge and skills not otherwise available but essential to research outcomes (Beaver & Rosen 1978, 1979a; Thornsteinsdottir 2000). Researchers pool resources to jointly purchase and use costly equipment, without which research would be less efficient or impossible, and funding agencies are driving collaborative research by facilitating collaborations as part of their funding conditions (Beaver & Rosen 1979b; Meadows 1974; Thorsteinsdottir 2000). An increase in the number of individuals participating in research is another benefit, where collaborative projects draw in people who have previously not been involved and who might not have contemplated initiating a research program. By extending the circle of researchers, perspectives broaden, and more expertise is added to the field. Besides the super ordinate goal of the collaboration, collaborative research has a social context where partners fulfill their individual goals (Sonnenwald 2007). In many cases, collaboration is the key mechanism for mentoring graduate students and postdoctoral researchers and enhancing the productivity of individual scientists (Bozeman & Corley 2004; Melin 2000).

Publishing productivity may not be directly related to collaborative research however, in the presence of moderating variables; the simple number ('normal count') of peer-reviewed journal papers is strongly and significantly associated with the number of collaborators (Lee & Bozeman 2005). It is important to note that many studies simply could not be carried out by individual scientists working on their own, especially not in a research environment in which science is increasingly interdisciplinary, equipment-dependent, and project-based.

Data sharing offers a wide range of advantages for people engaged in scientific inquiries as well as science-based applications, such as nature conservation, whether professionals, hobbyists, or researchers. Data sharing allows for data added to existing datasets, meta-analyses, as well as validation and testing reproducibility of studies, and policy and strategy development. When data sharing occurs through cloud platforms, the information becomes accessible to practitioners. Although there are constraints that arise with transparency which relate to confidentiality, differing interests of collaborators, and informed consent, data sharing remains a beneficial aspect of collaborative research (Nielsen 2013; Anderson 2013; Foe & Larson 2016).

1.20. Challenges to collaborative research and data sharing

Impediments to collaborative research include geographic distance which consumes significant travel costs and time to allow researchers to discuss, in person,

conceptual aspects of the research (Goddard *et al.* 2006). Distance resulting in different time zones further complicates communication favouring emails rather than face-to-face or telephone communication. Dependence on funding and the lack of it affects researchers' abilities to network at international conferences and workshops (Morrison *et al.* 2003).

Research contexts (countries and cultures) may influence consistency in project focus and deliverables especially when partner institutions have different requirements and processes. As a result, co-investigators end up receiving different types of information and following different approval procedures. Lack of training resulting in poor data organization skills (Stuart et *al.* 2018) and limited knowledge about data sharing and management give way for misinterpretation and misuse of data (Kervin *et al.* 2014; Tenopir *et al.* 2011). Limited expertise in Information technology (IT) and "internet-of-things" limit the possibilities for scientists and practitioners to share data and collaborate with others simply because they do not know where and how to share data (Stuart *et al.* 2018). Legal constraints differ between countries¹ of collaborating partners concerning copyright, intellectual property rights, and confidentiality (Michener 2015; Uhlir & Schröder 2007). The absence of long-term funding and support for the management of data and online platform maintenance may lead to their discontinuation.

1.21. Motives behind collaborative research

Several motives for the researcher to engage in collaborative research were defined conceptually by Beaver & Rosen (1978) and these include access to special equipment and facilities, access to special skills, access to unique materials, access to visibility, efficiency in the use of time, the efficiency of use of labour, to gain experience, to train researchers, to increase productivity, to multiply proficiencies, to avoid competition, to surmount intellectual isolation, need for additional confirmation of evaluation of a problem, need for stimulation of cross-fertilization, spatial propinquity, and accident or serendipity. More recently, a survey with university professors revealed that motives behind collaborative research were primarily pragmatic such as special competence of the collaborator (41%), special data/equipment he/she owned, and the development and testing of new methods (9 %) Melin (2000). The author also reported social motives behind collaborative research such as friendships and successful past collaborations (16 %), as well as relations with students' supervisors (14%). Regarding the benefits of collaborative research, these revolved around enhanced knowledge (38 %) and research quality (30 %), networking (25 %), and the generation of new ideas (17 %).

¹ To find the appropriate database in a universe of cyber infrastructure, the Registry of Research Data Repositories has committed their work to facilitate the ubiquity of data available to scientists (https://re3data.org). This web platform provides over 1000 data repositories from multiple domains (Pampel *et al.* 2013, 2014). It consists of a search engine that acts as a gateway to many registered databases such as the Northern Ontario Plant Database for example, or the India Water Platform which are two databases of different domains being flora or water management.

1.21.1. Components of collaborative research

Components leading to effective collaborative research were identified by Wine et *al.* (2017) following a review of collaborative research on environmental health. The authors identified external or institutional components that impact prospects of collaboration and interdisciplinary work, and internal components, inherent to the operational dynamics within a team and related to team productivity. Below is a summary of external and internal best practices relayed by Wine *et al.* (2017).

1.21.2. External components

Adequate funding to support interdisciplinary participation is essential because collaborative research is a lengthy process that requires traveling, meeting events, and appropriate technology to allow for communication, data collation, licensing, and network sharing. Acknowledgments and reward systems for participants engaged in data sharing should be based on clear guidelines and supported by standardized cyber policy including copyright and intellectual property which differ between countries and projects.

Training of participants in new tools of collaborative research is important and should be planned and accounted for during the formation of a collaborative research team because research tools are continuously being updated and new ones introduced.

Institutional support for including communities in collaborative research by hiring community members to participate in collaborative research projects is crucial and requires institutional endorsement at the level of the ethics board, and policies need to favor such practice and promote data sharing with participants to maximize transparency and efficiency.

1.21.3. Internal components

Allocating time and equitable distribution of resources for networking through a fair distribution of funds to maintain harmony in the group and allow bonding between collaborators which is a long-term process that requires travel and time commitment beyond assigned project meetings.

Addressing disciplinary and sectoral issues which are often challenging when certain disciplines dominate over others in dictating approaches, when collaborators from different institutions and regions, and sometimes different languages, have divergent ideas, goals, and priorities, or when discipline legitimacy, credibility, and scientific independence is a priority for individuals in the group. This could inhibit the effectiveness of team efforts if proper cooperation is not in place to ensure that collaborators remain motivated to work together towards one common goal.

Building relationships is a pillar of the entire collaborative research process which ensures that trust and professional relationships will maximize motivation for knowledge co-production and help address power imbalances. Ensuring representation of all stakeholders to maximize the potential of collaborative research is a challenge either due to poor stakeholders' representation or the refusal of some to collaborate.

Embedding participation in the research is essential to enhance participation in research through the early involvement of partners in the planning phases of the research, building on previous mutual experiences, and performing preliminary background work on contextual factors and policy processes.

Supporting ongoing collaboration by maintaining dialogues through frequent inperson meetings is essential however work balance between stakeholders may limit these possibilities. Instead, challenges that may arise during the research project can be mitigated by setting collaborative goals, strategies, limitations, and models of participation by partners in the early stages of the process. The inclusion of a social scientist in the research group may support effective collaboration and provide feedback and critical reflections to optimize the research protocol as research evolves.

Developing knowledge translation and exchange is a major issue in collaborative research because it needs to consider disciplinary jargon which may affect communication of findings between partners and will benefit from a knowledge translation plan implemented by a team member A good way to mediate this is to assign one of the collaborators an intermediary role to disseminate results promptly and address any issues related to data ownership before dissemination.

1.22. The Mediterranean Basin: asymmetries between Northern and Southern Mediterranean countries

The Mediterranean basin includes 136 biosphere reserves in 22 countries which together share a 46 000 km coastline across Africa, Asia, and Europe, and rich common history of sea merchants and travellers facilitating trade and cultural exchange between peoples of the region. Today, Mediterranean countries differ concerning their system of governance, level of economic development, and commitment to regional integration and fall under multiple sub-regional entities such as the EU-27, EU candidate countries, the Mashreq (Levant), the Maghreb, the Arab League, the Organization of Islamic Cooperation, and the African Union.

1.22.1. Economic development

Many southern Mediterranean economies remain agriculture and energy-based "rentier-states", with a developing service sector, while north Mediterranean economies maintain a strong industrial base and high-tech service industry that promotes a "knowledge society" (Beblawi 1990). While northern Mediterranean countries are open and export-oriented, many south Mediterranean countries maintain relatively closed and state-controlled economies. North Mediterranean countries are the largest exporters in the world, and some are prime locations for global investment, while southern Mediterranean countries have consistently captured a low share of world trade, technology exports, and foreign direct investment (Abdelkrim & Henry 2009). In fact, although one-fifth of the Organization for Economic Co-operation and

Development (OECD) members are Mediterranean states, none of the OECD members are Mediterranean Arab states.

1.22.2. Human and social development

Populations in many North Mediterranean countries are aging while their southern counterparts are experiencing a "youth bulge" with 60 % of the Arab population currently below 25 years of age (Johansson de Silva & Silva-Jauregui 2004). North Mediterranean countries are facing skill shortages and mounting fiscal problems, while most southern Mediterranean countries fare poorly on global human development indexes and Arab Mediterranean countries face rampant unemployment, food shortages, environmental degradation, and water scarcity (United Nations Development Program, 2009; UNDP^b, 2009).

1.22.3. Trade and economic integration

Throughout history, the Mediterranean was central to global trade and commerce, however more recently the region has turned into an economic characterized by one of the lowest levels of trade integration in the world. Despite attempts to establish regional and sub-regional free trade areas, the level of trade and economic integration amongst the southern Mediterranean countries remains considerably below the level achieved by other regional organizations, such as NAFTA or ASEAN (World Bank Group, 2008). In contrast, the level of trade integration between southern Mediterranean countries and the EU is more advanced although it remains shallow and fraught with serious obstacles.

1.22.4. Scientific contribution and representation

The discrepancy in scientific publication and quality of research between northern and southern Mediterranean basin countries is high relative to population size (Sweileh et *al.* 2015). Scientific works in southern Mediterranean countries are also less likely to be represented in relevant datasets. For example, one of the most comprehensive compilations of research on Biosphere Reserves, the International Journal of UNESCO Biosphere Reserves, includes more than 2700 publications, none of which are from the 20 biosphere reserves present in the Levant Arab and North African states. This may give the impression that there is no research on Biosphere Reserves in these countries and may limit collaboration with interested researchers elsewhere.

1.22.5. Impediments to collaboration across the Mediterranean

Remote collaborative activities between countries in the Mediterranean are still difficult despite sophisticated cyber infrastructure which is not enough to mitigate the complex reality of region where individuals lack common vocabulary and working styles, and where attempts to store, publish, and share data using globally accessible tools is hindered by time restrictions and lack of information (Stuart *et al.* 2018). Furthermore, conditions needed to allow the necessary space and time for reflection
and collaborative efforts are hindered by the rapid pace of today's academic world and the dominant mode of evaluating scientific performance (Guimarães et *al.* 2017). The limited participation of researchers from southern Mediterranean countries in global studies is another challenge to a balanced understanding of enablers and barriers to collaborative research in the Mediterranean. In 2018, Springer Nature published a white paper² entitled 'Practical challenges for researchers in data sharing' with 7,700 respondents. The findings revealed a discrepancy between northern and southern Mediterranean countries because most Mediterranean participants in this global study were from north Mediterranean countries (96.7%). The lack of participation from southern Mediterranean researchers in this study does not allow one to draw conclusions concerning limitations for data sharing, as well as collaborative research in general, across the Mediterranean.

1.22.6. Regionalism and conflict

While the Mediterranean basin countries share a common history and similar cultural traits, there are few places in the world today that are more politically divided and conflict-ridden. As a result, the region has become home to a unique blend of different Pan-Arab, EuroMediterranean³, Pan-African, and Maghreb projects of region-building that are evolving both in concert and competition. Political and economic orientations and allegiances are pulling Mediterranean countries in different directions leading to a stifled regional situation that has translated itself into a long list of ethnic groups, territories, and countries with limited or disputed recognition as well as countries with rogue state labels.

1.22.7. Academic boycotts

It can be generally stated that the progress of academic work relies on the free exchange between researchers as indicated in the Statute 5 of the International Council of Science (ICSU): 'The principle of the Universality of Science (and Learning)⁴ is fundamental to scientific progress. This principle embodies freedom of movement, association, expression, and communication for scientists as well as equitable access to data, information, and research materials. In pursuing its objectives in respect of the rights and responsibilities of scientists, the ICSU actively upholds this principle, and, in so doing, opposes any discrimination based on such factors as ethnic origin, religion, citizenship, language, political stance, gender, sex, or age.' In light of ongoing conflicts that plague the Mediterranean basin, the Principle of Universality

 $^{^{2}}$ A white paper is an authoritative report or guide that informs readers concisely about a complex issue and presents the issuing body's philosophy on the matter. It is meant to help readers understand an issue, solve a problem, or make a decision.

³ Mediterranean regionalism is seen as largely a European union (EU) project, potentially instrumentally valuable in the southern and eastern Mediterranean, but not yet a focus for shared identity (Schoenfeld & Rubin, 2004).

⁴ The reasoning that underlies the Principle of Universality in the natural sciences also applies in part (and with appropriate modification) to the social sciences and the humanities. We shall therefore refer to the Principle of the Universality of Science and Learning (or simply the Principle of Universality), which we take to refer to all the academic fields collectively.

clearly stands in tension with the practice of academic boycotts 'the systematic withholding of normal professional relations from academics as a means to achieving some goal, typically either punishment or the bringing about of some change in behavior or policy (Rodin & Yudkin 2010).' Boycott action may include refusing to attend conferences or engage in collaboration; withholding data or results; refusing requests from universities to comment on applications for promotion of university staff; refusing to referee or consider articles submitted to learned journals, or refusing applications for university posts.

1.23. Travel limitations

The issuing of travel visas is another threat to collaborative research as not all researchers in Mediterranean basin countries can travel freely to attend conferences and visit collaborators.

1.23.1. Language barriers

Cultures and Languages of the Mediterranean are diverse and complex to the extent that the University of Göttingen offers a degree in 'Cultures and Languages of the Mediterranean'. In the North Mediterranean basin, there are more languages than there are states which are divided into regional dialectal groups, further subdivided into local dialects⁵. Furthermore, many European countries recognize minority languages and sub-official languages⁶. In Turkey, there are 43 languages, some spoken by as little as 300 people, even though Turkish is the official language of the country (Yagmur, 2001).

Modern Standard Arabic (MSA) is the official language of all Mediterranean Arab countries, however, because of Diglossia in the Arabic Language⁷, this does not

⁵ A dialect can be simply defined as a variety of a language, which is spoken locally and considered to be a less formal and less prestigious variety of that language (Wardhaugh & Fuller, 2015) and has a distinctive construction and inflectional elements (Milllar & Trask, 2015). Over time, these dialects gain different linguistic aspects that diverge from the mother language and from each other. Eventually, these dialects evolve to be different, independent languages (Milllar & Trask, 2015). An additional factor that has a role in determining the number of languages in the world is whether to consider the different varieties of a specific language to be different languages or different dialects (Comrie, 2009).

⁶ The European Charter for Regional or Minority Languages (ECRML) is a European treaty (CETS 148) adopted in 1992 under the auspices of the Council of Europe to protect and promote historical regional and minority languages in Europe.

⁷ Diglossia in general is "a situation in which there are two distinct codes with clear functional separation; that is one code is employed in one set of circumstances and the other is an entirely different set" (Wardhaugh& Fuller, 2015). These codes are related to each other but regarded as different varieties, which each is used differently depending on the reason and situation. Thus one is high and the other is low. An example of diglossia is the Arabic language. Diglossia in Arabic is said to be an old linguistic situation that arose during the spread of Islam, when the Arabic language came into contact with other languages and non-Arabs began to speak Arabic. It refers to the existence and use of two or more types of Arabic in an Arabic-speaking country. Of these types of Arabic, one is MSA considered to be the high variety, while

facilitate collaborative researcher among these countries because citizens are more proficient and comfortable in their Arabic dialect subgroups⁸ (Zaidan & Callison-Burc 2013; Al Suwaiyan 2018). As a result, when meetings are organized between researchers of Mediterranean Arab countries the meeting language is usually a foreign one, namely English or French.

English is the commonly used language in research settings. Many students in most Mediterranean countries learn English as a foreign language including countries that used to teach Russian. On the other hand, North African Mediterranean countries teach and use French in research settings. As a result, Mediterranean Scholars who are proficient in French and English are at an advantage in forming collaborations without being restricted to either English or French-speaking partners. Furthermore, this schism in research language use only adds to the costs of collaborative research projects because it requires the services of interpreters in conferences and translations of project documents.

1.23.2. *Institutional structures promoting collaborative research in the Mediterranean*

There are several institutional frameworks and collaborative research centers that seek to promote collaboration, whether directly or indirectly, across the Mediterranean. This section will give a few examples of such initiatives.

- http://ame-emr.org/ameemr/Association for Medical Education in the Eastern Mediterranean (AMEEMR) aim is to develop the highest scientific and ethical standards in medical education and innovative management in the Eastern Mediterranean region through enhanced communication, regular conferences and educational events, exchange of teaching, research, and evaluation materials, mobility, and the dissemination of appropriate and Evidence-Based procedures;

– CIHEAM – International Centre for Advanced Mediterranean Agronomic Studies is a Mediterranean intergovernmental organization composed of 13 Mediterranean Member States with headquarters in Paris and four institutes in Bari (Italy), Chania (Greece), Montpellier (France), and Zaragoza (Spain). The CIHEAM's objectives are the combat all forms of waste, food and nutrition security, inclusive development, and prevention of crises;

- Collaborative Genomics for Human Health And Cooperation In The Mediterranean Region is rooted in the region's demographic history, the center is

the other is a colloquial variety which is the low one. Each type is used for a specific purpose (Al-Sobh et al., 2015).

⁸ Egyptian dialects are mainly spoken in Egypt; however, this dialect is widely known as it is often used in Arab film and television series" productions and is also the dialect used by many Egyptian teachers in Arab countries (Mitchell, 1976). The Levantine dialects are spoken in the northern portion of the Arabian Peninsula, such as in Jordan, Lebanon, Syria and Palestine. These dialects utilize unique intonations, which make them desirable to many Arabs. The Gulf dialects may be the closest in vocabulary and sound to MSA. The Maghrebi dialects, spoken in northern Africa such as Tunisia and Maghreb, were influenced by the French and Berber languages. As such, they are the most difficult dialects to be understood by other Arabic speakers (Zaidan & Callison-Burc, 2013).

devoted to genomic analysis of Mediterranean populations to offer unique insights into human evolution and early human migration;

- CREM - Centre for Economic Research on Mediterranean Countries at the Akdeniz University was established to promote the relationship between Turkey and Mediterranean countries by focusing on free trade agreements, agriculture, energy, tourism, and migration issues;

- Euro-Mediterranean Center on Climate Change (CMCC) is a non-profit research institution established in 2005, with the financial support of the Italian Ministry of Education, University, and Research. CMCC manages and promotes scientific and applied activities in the field of international climate change research and represents an institutional point of reference for decision-makers, public institutions, as well as private and public companies seeking technical-scientific support;

– Euro-Mediterranean Study Commission (EuroMeSCo) is a network of research centers in the Euro-Mediterranean area comprising 104 institutes including 29 Mediterranean countries with the mission to foster Evidence-Based and policyoriented analysis on Euro-Mediterranean politics and policies through joint research programs, to provide a platform for dialogue between researchers and with key stakeholders, and to boost the role of and research institutes in strengthening Euro-Mediterranean relations;

- Institute of Mediterranean Agricultural and Environmental Sciences (ICAAM) is a Research and Development Unit at the University of Évora that engages multidisciplinary teams to develop knowledge contributing to the sustainability of Mediterranean agriculture and associated ecosystems, through the efficiency in the use of production factors; the quality and added-value of agri-food products and Ecosystems integrity and landscape multifunctionality;

– International Centre on Mediterranean Biosphere Reserves, Two Coastlines United by their Culture and Nature is a center located in Spain which documents scientific research and knowledge on all biosphere reserves in the Mediterranean basin and serves as a platform for training and transferring advanced knowledge on environmental and societal issues between countries and will facilitate joint programs between biospheres reserves;

- International Union for Conservation of Nature's Centre for Mediterranean Cooperation (IUCN-Med) purpose is to influence, encourage and aid Mediterranean societies in achieving sustainable development - while conserving their natural resources and ensuring they are used sustainably;

– Islamic Cooperation Youth Forum (ICYF) includes many Mediterranean countries that are members of the Islamic Cooperation Youth Forum (ICYF) which seeks to promote the exchange of ideas and experiences, increase youth involvement in society, promote solidarity among youth organizations of the region, promote international collaborative projects that support solidarity, dialogue and cooperation among youth organizations and address problems faced by youth in these countries;

- Mediterranean Institute for Environmental Studies mission is to become a reference center for responsible research and innovation on social, economic, and environmental issues in the Mediterranean region. Interdisciplinary research teams

focus on sustainable management of natural resources, adaptation to climate changes, sustainable lifestyles, quality and safety food production and nutrition; development of a sustainable and inclusive society, and sustainable rural and urban development;

– Network of Mediterranean Plant Conservation Centers (GENMEDA) is a network of seed banks and conservation centers of genetic resources of the Mediterranean flora. GENMEDA's members from 12 Mediterranean countries contribute to the network through the improvement of human capital, sharing equipment and methodologies to boost applied knowledge; creation of living plant collections; joint initiatives, and encouragement of environmental education and public awareness on biodiversity conservation;

- Organisation Internationale de la Francophonie includes many Mediterranean countries are members or observers at the International Organization of the Francophonie (OIF) which seeks to connect various French-speaking peoples to promote cultural and linguistic diversity, peace, democracy, and human rights, education, training, higher education, and research;

- Regional Activity Centre for Specially Protected Areas (RAC/SPA) was established in Tunisia for the protection of the Mediterranean Sea Against Pollution. RAC/SPA promotes research and includes coordinating capacity-building and technical support. RAC/SPA's mission is to provide assistance to Mediterranean countries in the implementation of their commitments under the SPA/BD Protocol;

– Union for the Mediterranean (UFM) is an intergovernmental organization of 42 member states including 15 Mediterranean partner countries, aims to promote stability and integration throughout the Mediterranean region. UFM's goal is to increase north-south and South-South integration in the Mediterranean region and to support the countries' socioeconomic development through projects that have a direct impact on common regional challenges.

1.24. Conclusion

Collaborative research in the Mediterranean basin is hindered by asymmetries at the social, cultural, economic, political, and research capacity levels. On the other hand, Mediterranean countries share a common ecogeographic identity and a natural heritage that has shaped the relationship between people and nature, and molded comparable traditions and rural lifestyles around the basin. Biosphere reserves, which capitalize on this relationship between people and their environment, offer an opportunity to 'ground' collaborative research that targets problems and capitalizes on opportunities peculiar to such areas. To promote and sustain collaborative research between stakeholders of biosphere reserves, including researchers, practitioners, residents, and society at large, there is a need to identify specific motives behind such collaborations that will eventually lead to the formation of a community. For example, similar socio-ecological problems that are addressed through the same approaches and rely on the same skill sets and knowledge may be a motive for engaging in collaborative research with the Mediterranean Biosphere reserve community to gain experience from success stories in other Mediterranean biosphere reserves, and receive training from researchers and practitioners. Through collaborative research, the potential of Mediterranean biosphere reserves to evolve through similar paths and contribute to the wellbeing of people will, in turn, give biosphere reserve stakeholders the incentive to work together and build friendships driven by a common sense of belonging to a 'Mediterranean people', which in turn sustain collaborations. For such collaborative research to see the light and sustain itself it will need to address basic elements of collaborative research such as the provision of adequate funding to support interdisciplinary practices, facilitating data sharing, offering opportunities for and facilitating mobility, ensuring representation of all stakeholders, and promoting inclusion by adopting the main Mediterranean languages, etc. Partners in the Edu-BioMed project have taken small steps towards providing digital support for promoting collaborative research between stakeholders of Mediterranean biosphere reserves through the development of a collaborative digital platform that will serve as a portal that serves as a communication platform between the Mediterranean Biosphere stakeholder community, and integrates information generated by stakeholders, featuring recent work and publications, and providing links to the various biosphere reserve tools and repositories.

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Chapter 4

Environmental Education and SDGs, an opportunity in Mediterranean Biosphere Reserves. Some reflections.

Martí Boada

It is clear evidence that we find ourselves in a context of a civilisational crisis (transversal), not strictly of civilisation (local) without known historical precedent. The manifestations of this crisis are abundant and expressed in a variety of ways.

All of this is taking place in a context in which it is recognised that there is an acceleration of processes, which shortens the social capacity to react with sufficient celerity and urgency.

The UN's declaration of a Climate Emergency is the strongest evidence of the gravity of the moment, which has been compounded by the Covid 19 pandemic crisis.

The institutional tools put in place around the 2030 Agenda and its 17 Sustainable Development Goals (SDGs) can be a promising avenue and the Biosphere Reserves (BRs) an appropriate field of experimentation.

The question is whether there is enough time to correct the environmental crisis that has unfolded. We are hopeful that this is the way forward, but we cannot dwell on it for a minute. As Bellamy reminds us, those of us involved in the management and dissemination of sustainability cannot be fiddling while the forest is being burnt down. There is no point in conflicting disciplinary positions, or corporatist discussions, or exclusivist truths, we all need each other at this special juncture of the emergency.

From an educational perspective, and especially in the sense of raising awareness about the moment and the necessary deployment of the Sustainable Development Goals, it seems highly advisable to move away from clichés. As is well known, clichés are the furthest thing from real knowledge.

It is advisable to train to understand (IUCN document, One Earth). Do not scare pupils, students and adult recipients of our messages with extreme alarmism. As Paul Ehrlich points out, if we scare the addressee, as a simple defence mechanism, they will look away from the problem. Let us remember, training to understand, since, as Margalef points out, a well-informed person always multiplies, a badly-informed person at least subtracts.

There is urgency, no doubt, but as a Spanish aristocrat used to say to her valet, "dress me slowly, I'm in a hurry". Forgive an author's note, we have no ideological sympathy for the aristocracy, it is simply a metaphor in the service of a pedagogical reflection, which requires real urgency.

And if Biosphere Reserves are privileged spaces for experimentation in the field of biodiversity conservation, they are also privileged as testing grounds for environmental education. In this sense, we would like to recall that biodiversity, as well as its cultural and social dimension, are highly stimulating elements, both for students and for adult society. A well-preserved landscape is above all an exceptional classroom.

Socio-ecosystems are a university, where the learning possibilities are unlimited. It is highly advisable to work with techniques of knowledge of the environment, taking advantage of the scenario represented by a Biosphere Reserve, in our case and its various variables, are a sample of cultural and ecological Mediterranean, with what it represents biogeographically and 'civilizationally'.

In the face of increasing climate change, BRs become sentinel landscapes, leading indicators of the changes expressed in biomes due to the increasing climatic environment. In this context, biodiversity, in addition to its undeniable value as heritage, which must certainly be protected, becomes a magnificent indicator of the changes produced in the territory and landscapes as a result of serious environmental alterations. In these circumstances, beyond the values and curiosities of the biodiversity of BRs, by applying appropriate models it is a very rigorous indicator of sustainability.

In turn, BRs can be a meeting point for the generation of cooperation and knowledge transfer links between academia and derived research and citizens. In this meeting space that is BRs, managers have a key role to play. These in turn should promote strategies for overcoming conflicts between formal and informal education, and work on the participatory processes of the populations linked to BR, in order to achieve, as far as possible, the goals of the SDGs.

Chapter 5

The biosphere reserve model in national legislation and public policies within and around the Mediterranean

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1.26. Introduction

Biosphere reserves were established as part of UNESCO's 1970s intergovernmental scientific Man and the Biosphere (MAB) programme. Initially sites of research and scientific monitoring, and the programme's territorial bases (Jardin 2021), they now offer an integrated approach balancing the conservation of biodiversity and biological resources, and support for sustainable development of populations based on the broadest meaning of knowledge: scientific monitoring and research to better identify the challenges of the territories in all its natural and human components and respond appropriately; education, training, awareness, local participation in the perspective of greater understanding of these issues by the greatest number. They represent demonstration sites for the implementation of the United Nations' 2030 Sustainable Development Goals (UNESCO 2016).

Since 1995, the functions and criteria governing biosphere reserves have been set out in texts officially endorsed by UNESCO's General Conference, the Seville Strategy and the Statutory Framework of the World Network of Biosphere Reserves (UNESCO 1996). A very high number of countries have now established biosphere reserves, as part of a world network: 727 in 131 countries in 2021. Being formal designated by UNESCO means that biosphere reserves are a model for management as well as being considered to be a prestigious international label leading to heritage designation. What part does the first characteristic play in engaging countries under the MAB framework? This article aims to identify whether the four Mediterranean countries (Lebanon, Morocco, Spain, France) have taken up this management model and whether, 25 years after the adoption of the text, they have integrated it into their legislation and institutions and the extent to which they have put it into practice. What links have been established between the MAB programme (often initially linked to the scientific community) and public policies? In what way does it feed into the means of managing and conserving biological resources, biodiversity, or influence the management of territories and local development?

1.27. The place of Biosphere reserves in national legislation

Biosphere reserves are included in legislation in both European countries, but not in Morocco and Lebanon (Table 1).

Country	Biosphere Reserves in National Legislation	Date came into legislation	Mention
Lebanon	No	-	
Morocco	No	-	
Spain	Yes	2007 and 2015	The Natural Heritage and Biodiversity Act (Art 3.31, 65, 66 and 67). Updated in Law 33
France	Yes	2016	Reconquest of Biodiversity Act, Article 66

 Table 6.1. Mention of biosphere reserves under national legislation.

Lebanese law does not mention biosphere reserves. They are designated by UNESCO but protected only to the extent that local jurisdiction enacts an appropriate legal framework and law enforcement. In Lebanon, protection of natural sites legislation dates back to 1939 and, where applied, provides a broad measure of protection to many natural and cultural sites. A new Protected Areas Act was introduced in 2019 under the supervision of the Department for the Environment. It encompasses public and private protected areas and sets out details on the planning and management requirements for initial designation and preservation of status.

The added value of biosphere reserves comes from the fact that instead of simply protecting the flora and fauna of a particular area, conservation is to promote ecosystems that benefit the greatest number of rural and urban people. To achieve this new approach, an essential first step is the delineation of all public and private land holdings and the implementation of land use regulations. Without these two parameters delineating and regulating land use, most conservation activities will fail.

In Morocco, the law does not explicitly mention biosphere reserves, and there is no specific legal instrument for the transposition and implementation of the MAB programme into national legislation and policy. Therefore, regulations that incorporate Morocco's commitments to the MAB programme are limited to the signing and ratification of international agreements/conventions (such as the Convention on Biological Diversity in 1996) along with official support for each biosphere reserve's designation, framework and action plans, and periodic reviews to be submitted to UNESCO. But when Act 22-07⁹ on protected areas of August 2010 (State Bulletin (BO) 19/08/2010) was revised, the recasting of the legal framework has adapted the criteria applicable to international recognition to the conditions relating specifically to Morocco. This evolution tends to involve administrations, local authorities, local organisations and NGOs in the management and sustainable development of protected areas. This Act 22-07 enables consideration of the management of protected areas as a tool for conservation and enhancement of biodiversity and sustainable local development. However, the absence of an implementing decree defining the responsibilities of stakeholders and mobilisation of financial and human resources makes this Act 22-07 less visible.

The two European countries, Spain and France, have systems based on UNESCO texts:

– In Spain, the MAB programme has received strong institutional support, strengthening the national network of biosphere reserves and enshrining it in law since 2007. Act 42/2007 of 13 December on Natural Heritage and Biodiversity takes into account the existence of biosphere reserves (Articles 3.31, 65, 66 and 67). Article 65 states that Spain's Biosphere Reserves Network is a defined and recognisable subset of the World Network of Biosphere Reserves. The text takes into account the goals of UNESCO's MAB programme, allowing for biosphere reserves to potentially include other protected areas. Their characteristics are based in particular on the criteria of Article 4 of the world network's statutory framework (UNESCO 1996): zoning, governance, etc. The 2007 Act was updated by Act 33/2015 of 21 September 2015;

– In France, the law mentions biosphere reserves at a later stage. The 2016 Reconquest of Biodiversity Act (Article 66) deems that biosphere reserves contribute to the sustainable development goal. It stipulates that "in applying UNESCO General Conference Resolution 28C/2.4, approving the Seville Strategy and adopting a Statutory Framework of the World Network of Biosphere Reserves on 14 November 1995, local authorities, their groups and mixed syndicates mentioned in Chapter VII of the fifth part of the General Code of Autonomous Regions, associations and national public establishments of an administrative nature, may set up a biosphere reserve. A biosphere reserve contributes to sustainable development goal defined in Article L. 110-1 (II) of this code. The national strategy for biodiversity promotes the development of biosphere reserves in metropolitan and overseas France. "

This text does not define the biosphere reserve as a new protected area category, as France already has a full range of them. It provides for them to be organised on the basis of one or more administrative structures (in support of different types of protected area and local authorities) and associations combined according to the specific biosphere reserve zoning model. Unlike in Spain, the law does not refer to the network(s) of which they are part, either nationally or internationally.

⁹ Dahir No. 1-10-123 of 3 Sha'ban 1431 (16 July 2010), enacting the 22-07 Protected Areas Act. This legislation does not mention the biosphere reserve among the protected areas recognised in Morocco.

1.28. The role of the MAB's National Committees in national governments

Country	Creation date	Form in 2021	
Lebanon		Committee chaired by a scientist (CNRS - French National Centre for Scientific Research), which ensures the link with the biosphere reserve support structures.	
Morocco		Honorary committee, created in 1995, made up of volunteers and chaired by a scientist, which represents the biosphere reserve at national or regional meetings. This committee works in conjunction with the Water and Forests (High Commission) Board that is in charge of protected areas, NGOs and ANDZOA.	
Spain	1975	An inter-ministerial collegiate advisory body with representatives from: several general government departments, all autonomous communities with biosphere reserves within their territory, biosphere reserve managers, representatives from the scientific sector as well as other stakeholders.	
France	1973 (and 2015)	MAB France Association (Law 1901) since 2015, which groups together biosphere reserves, national scientific institutions (CNRS, INRA, CIRAD, MNHN, IFREMER, IRD), relevant government departments (foreign affairs, environment, research and education), public and private partner organisations dealing with biodiversity and sustainable development issues, individual researchers and experts. The chairperson (who is also France's representative to the MAB ICC) is appointed by the Minister for Foreign Affairs. Before and since 1973, the MAB Committee was brought into UNESCO's National Commission.	

Table 6.2. Organisation of MAB National Committees.

1.28.1. Spain

According to the historical reconstruction of the Spanish Autonomous Organisation of National Parks (OAPN - Organismo Autónomo de Parques Nacionales, 2012), Royal Decrees 342/2007, of 9 March 2007, and 387/2013, of 31 May, now govern the development of the functions of the MAB programme, as well as of the Spanish MAB Committee, within the OAPN.

Since its creation in 1975 within the Spanish Commission for Cooperation with UNESCO, the UNESCO's MAB programme's Spanish Commission has undergone a significant evolution during which several stages can be identified.

Between 1975 and 1987, the Spanish MAB Committee functioned as a working group as part of the Spanish Commission for Cooperation with UNESCO. At this stage, its composition was essentially academic, although representatives from the fields of management and administration were gradually brought in.

In 1987, with the creation of a MAB Committee Support Office within the Department of Public Works and Urban Development's General Environment Directorate, the MAB Committee's activities received a strong impetus that, over time, began to focus on the biosphere reserve concept (OAPN, 2012). As a result, a technical working group on biosphere reserves was created in 1992, which marked the beginning of networking in Spain. The development of the tasks of this group culminated in the Spanish contribution to the 2nd International Biosphere Reserves Conference, Seville 1995, organised by UNESCO. The period 1987-96 can be considered a period of mutual knowledge and interest between the Spanish MAB Committee and the public institutions responsible for the environment - both at national and regional levels.

Royal Decree 1894/1996 of 2 August 1996, which refers to the structure of the Department for the Environment, assigned the MAB programme's coordination and development functions to OAPN (OAPN, 2012). These coordination functions were continued with Royal Decree 1130/2008, of 4 July, regarding the organisational structure of the Department for the Environment and Rural and Marine Affairs. Royal Decree 401/2012, of 17 February, which develops the basic organisational structure of the Department of Agriculture, Food and the Environment, does not change the functions of the Autonomous National Parks Organisation in terms of the MAB programme's development in Spain. Thus, since 1996, OAPN has provided support to a technical office to assist in the development of the MAB Committee's activities. Between 1996 and 2007, the MAB Committee continued to carry out its activities, including increasing the number of Spanish biosphere reserves and the impetus given by Spain to the IberoMaB network (a network that brings together the countries of Latin America, the Caribbean and the Iberian Peninsula).

Royal Decree 342/2007, of 9 March 2007, regulates the development of the functions of the MAB programme, as well as the Spanish Committee and its advisory bodies (Scientific Council and Management Board), within the OAPN. This Royal Decree, which clarified the way in which the OAPN performs its functions, provided institutional support for the operation of the MAB programme in Spain and gave new impetus to the development of the programme's activities. Almost simultaneously, the inclusion of Biosphere Reserves in the Natural Heritage and Biodiversity Act 42/2007 provided regulatory support and consolidated Spain's Biosphere Reserve Network.

The decree also specified the composition and functions of the Spanish MAB Committee, as well as its links with government, making the Committee an effective institutional coordination body for biosphere reserves and for the transfer of initiatives to institutions. From now on, the Spanish Unseco MAB committee is an interministerial collegiate advisory body with representatives from several general government departments, all autonomous communities with biosphere reserves within their territory, biosphere reserve managers, representatives from the scientific sector as well as other stakeholders. The MAB Committee has two advisory bodies: the Scientific Council and the Biosphere Reserve Management Council, which are highly active in creating initiatives and implementing Spanish biosphere reserves.

Spain's investment in the MAB Programme is particularly interesting, given that, in addition to the Seville Conference, which provided the biosphere reserves with their texts, the 3rd World Biosphere Reserves Congress was held in Madrid in 2008, and the Seville +5 International Conference was held in Pamplona in 2000, which resulted in the recommendations that determine the modes of creating and operating transboundary biosphere reserves, which remain in force.

1.28.2. France

The MAB Committee was set up in 1973. From 1973 to 2015, the MAB Committee operated under the aegis of, and with the support of, UNESCO's French Commission. At this point, it was essentially academic in nature and included representatives from the government departments concerned (environment, foreign affairs, education). Biosphere reserve representatives have been associated with the MAB Committee since 1991. Its funding came mainly from the government departments in charge of the environment, with the departments in charge of foreign affairs, education and research providing limited additional funding. During its early years, the animation was ensured by a researcher of the ORSTOM (today known as IRD). The MAB Committee has recruited a scientific secretary since 1991, thanks to funding from the government department in charge of the environment. A CNRS researcher has also been associated with the MAB Committee's activities since 2002.

With the development of the national network of biosphere reserves - in particular three new sites joining the network between 2012 and 2014 - it has become necessary to give the French MAB Committee a legal personality for its activities. The aim was to give it the visibility it lacked and enable it to carry out more ambitious projects and better promote the "biosphere reserve" model in the context of France's conservation and sustainable development of territories. This was done in 2015 with the creation of the MAB France association. Its governance is based on the participation of its active members, major French research organisations and biosphere reserve support structures, as well as associate members, experts, government departments, institutional partners (notably the French Biodiversity Office) and associations. Its board of directors consists of 15 members, half of whom are biosphere reserves and half of whom are scientists, elected for three years. Its staff consists of two people (a director and a project manager), to which a CNRS researcher provides support.

Its main funding comes from the French Office of Biodiversity created in 2020, supplemented by modest support from the government departments in charge of foreign affairs, higher education and research and on a project basis. The association represents France's MAB committee and as such, manages the applications and periodic reviews. It leads the network of French reserves, working groups (research, youth involvement, EDD, forest management, communication) and projects related to the enhanced appreciation of companies and stakeholders within the territories (trophies, eco-stakeholders). It also co-directs the MAB master's degree at the University of Toulouse. The chair of France's MAB Committee (generally a recognised scientific personality) is appointed by the government minister in charge

of foreign affairs. They represent France on the MAB International Coordinating Council in relation to the French delegation to UNESCO.

1.28.3. Morocco

Morocco's MAB Committee was created in 1995, shortly before the establishment of its first biosphere reserve (the Arganeraie Biosphere Reserve declared in 1998). It is honorary and is made up of volunteers who are usually researchers with no management responsibilities. The current chair is in frequent contact with the Department of Water and Forests in Rabat and in relation with ANDZOA (the National Agency for the Development of Oasis and Argan Zones) and forestry administration. It is found in most of the biosphere reserve-related national debates and forums and in UNESCO international meetings - in particular in MAB's international coordination council. Like other southern Mediterranean countries, Morocco does not have a specific legal instrument for transposing and implementing the MAB programme in national legislation and policy.

1.28.4. Lebanon

The Lebanese Committee for the Man and the Biosphere Programme (LebMAB) is supported by the Lebanese National Centre for Scientific Research ("CNRS"). Initially consisting of three members of this body (Professor Tohmé, chair and Ghassan Jaradi, secretary), it was expanded to include a representative from each biosphere reserve (Chouf, Rihane and Jabal Moussa), following the World Biosphere Reserve Conference in Lima in 2016.

1.29. The role of the Biosphere Reserve model in public policies

The Manual for the Management of Biosphere Reserves in Africa (2018)¹⁰, published by the German Commission for UNESCO, puts forward two categories of governance structures: one called the "authority model"; the other, the "NGO model".

In the first of these, the approach is top-down, with the authority (a management unit under a government department or other authority) being primarily responsible for nature conservation and often only responsible for the core area (as well as sometimes the buffer zone). In this case, it may be difficult for it to be active in sustainable development, and in the transition zone.

In the second model (NGO), the management committee, composed of several private and public institutions, serves as a platform bringing together interests and communities. This model is well suited to consultation. However, it usually has no direct implementation authority and is often forced to negotiate with other institutions to implement decisions made by the platform. It is also more project-oriented than management-oriented. The integrated management of the whole is more difficult.

¹⁰ https://www.unesco.de/sites/default/files/2018-01/Manual_BR_Africa_en-1.pdf

Jardin (2017) proposes another distinction between existing structures and the ad hoc structures established for a biosphere reserve at the time it is created. The first category includes the organisation in charge of a protected area (whether extensive or not) or of a part of the area - for example: national park, nature reserve, natural marine park. It will have direct power of implementation, but provisions will have to be made to meet the objectives of the biosphere reserve, especially for the transition zone, where the body has no jurisdiction; an advisory management committee will need to be added.

IUCN category V protected areas should be treated separately, as they may include the transition zone and thus correspond to the biosphere reserve boundaries.

In other situations, where for example the perimeter is based on geography, ecology or culture, it includes a public governance body adapted to its needs, such as a town council with the addition of a management committee and associations, or the governance of an island (Menorca, Isle of Man) in which special arrangements are made to meet the objectives of the biosphere reserve. It comprises a group of institutions and municipalities (mixed association France - a public structure) or a group of partners, including associations (private structure). They can also be public/private partnerships. Where it is a private structure, its role will be advisory only.

The question of whether or not Biosphere Reserves should be classified as protected areas arises - as, in reality, only core and buffer zones are required to implement specific management measures for conservation. Transition areas cannot be taken to mean literally "protected areas". The concept of OECM (other effective conservation measure) better defines the expectations of their transition area: namely, "a geographically defined area other than a protected area, which is governed and managed to achieve long-term positive and sustainable outcomes for on-site biodiversity conservation, with associated ecosystem functions and services and, where appropriate, locally relevant cultural, spiritual, socioeconomic and other values" (CBD, 2018).

1.29.1. Spain

In 2021, the Spanish Biosphere Reserve Network had 52 sites in 16 of the 17 autonomous communities (OAPN, 2021).

The implementation of the biosphere reserve concept has evolved in Spain, as it has at international level. OAPN (2012) reports that from the initial biosphere reserves (named between 1977 and 1992), all biosphere reserves were previously nature parks, national parks or nature reserves, with the exception of Urdaibai which was declared in 1983 and covered by specific legislation. In 1993, Spain proposed designating two islands in their entirety: Lanzarote and Menorca. These also have a specific law. They contained protected areas, and were presented as integrated management projects for a complex territory, covering all productive sectors, all land uses and all inhabitants. Operational programmes were proposed for them based on participation and objectives consistent with sustainable development. The impact of these two experiences on the approaches adopted at the Seville conference in March 1995

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(UNESCO 1996) was significant. Between 1997 and 2006, 23 new territories were declared biosphere reserves. The rate of declaration of new reserves is decreasing, while their networking is being strengthened, based on a restructuring of the MAB Committee and the support given to the operation of biosphere reserves by the Autonomous Organisation of National Parks. The new situation offers solid support to Spain's biosphere reserves network, which is entering a period of intense activity aimed at improving their deployment, adapting them to the Seville requirements, for those biosphere reserves that did not have a sufficient organisational structure.

The increased requirements, however, have not diminished the number of territories aspiring to be part of the network. On the contrary, it seems to have had the opposite effect with many expressing their wish to apply to be declared a biosphere reserve.



Figure 6.1. Map of Spanish biosphere reserves (OAPN, 2019).

Santamarina Arinas (2015) offers a picture of the legal situation of biosphere reserves under each autonomous community's official regulations, and highlights the most important shortcomings. Figure 5 shows the patchwork of different institutional governance systems.

About half of the reserves (23) are governed directly by the autonomous communities' departments for the environment. Most of them overlap with protected areas, following the pattern of the end of the 20th century. This is the model selected by, for example, the regional governments of Andalusia, Extremadura, Madrid and Asturias. It has the advantage of strong budgetary security as well as being well-defined administratively. However, in some cases they suffer from shortcomings in

terms of meeting the objectives of the MAB programme, by focusing most of their resources on protected area conservation and logistical support of the core area to the detriment of socio-economic development. These areas are governed by specific regulations that define their functions in the field of conservation and with competences often limited to the environmental field, whilst hardly integrating other sectors that play a relevant role for the reserves: industry, tourism, culture, economy and so on.





The Sierra de las Nieves Biosphere Reserve in Andalusia is noteworthy: the biosphere reserve incorporates a natural park within its boundaries. The management of the reserve and park are coordinated, but independent. The managing body is organised around a collaboration agreement that establishes the town councils, an association and the autonomous community as being responsible for managing the natural park. The biosphere reserve manager is an employee of the group of municipalities and is responsible for the biosphere reserve's functions within the territory whilst being largely dependent on external resource opportunities. It is a success story that could well serve as a benchmark for other reserves.

Similarly, in regard to Odiel marshes (Andalusia) and the upper Manzanares basin (Madrid), the traditional pattern of overlapping protected areas and biosphere reserves is in place. However, at UNESCO's request, it was necessary to extend their boundaries beyond the natural parks.

The governance model is evolving to include town councils and stakeholders outside the park.

The local authorities (*diputaciones, cabildos* and *consells*) represent a governance mechanism that covers a quarter of the Spanish network's biosphere reserves (11).

They provide high levels of budgetary security and staffing. And although they have limited legal powers in the territory, they have a management capacity. They act as a liaison body between the autonomous communities and the town councils, with generally strong sectoral coordination.

Montseny should be noted: after a process of expansion beyond the natural park, it needed to reorganise its management model. The solution adopted was to integrate the park into the reserve's provincial council scheme, with the park director organisationally reporting into the reserve manager. Since then, the multi-functional model has shown exemplary performance. The park and its director focus on the conservation function in the core area. Working together with it, the biosphere reserve works on the other functions of the buffer and transition zones: socio-economic development and logistic support.

The other biosphere reserves are managed by an amalgam of local organisations that are not necessarily led by a government authority (foundations, associations of town councils, consortiums). One of their main weaknesses is budget insecurity. At the same time, however, they are extremely flexible and adaptable. This is the management formula selected, for example, by the biosphere reserves of Castilla y León and Aragón (Ordesa Viñamala). Special reference should be made to the Bardenas Reales Biosphere Reserve, managed by the Community of Bardenas, which has had full jurisdiction over its entire territory since the 9th century, as well as the Biosphere Reserves of Mariñas Coruñesas e Terras do Mandeo (A Coruña) and Allariz (Orense), which are managed by rural development associations under the supervision of the corresponding authorities.

The advantage of these more local models is, a priori, that they allow greater contact between the management bodies and the inhabitants and encourage their participation and involvement in the management of the territory. The main drawback of this management model is the lack of specific budgetary and/or human resources to manage the reserve.

Five autonomous communities have not yet developed a regulatory framework for biosphere reserves: Cantabria, Catalonia, Galicia, Balearic Islands and Navarra. This does not necessarily mean that their Biosphere Reserves lack management bodies and instruments.

Various situations show that having regional rules on biosphere reserves does not necessarily mean that there are sufficient regulations in these autonomous communities for organising and planning their management. The content of the regulations still in force in Andalusia or Castilla la Mancha (and more recently in Madrid and even, to a certain extent, in Castilla y León), perfectly illustrate what can be considered another way of not materially fulfilling commitments.

The remaining six autonomous communities are partially meeting their commitments. There are important differences in content depending on the local circumstances of each case and bring an interesting diversity that can enrich the whole and the exchange of experiences. It is also true that, it would be desirable in most cases to have adjustments or updates that offer a different scope. In general, however,

it can be said that the degree of compliance is higher in regard to organising biosphere reserves than in management planning.

Overcoming these difficulties, the autonomous communities could lack staterelated coordination tasks, where coordination entails not so much removing legitimate differences but putting forward a minimum set of shared guidelines to clarify any queries. In the meantime, this is not the only contribution that state legislature could pass to overcome the problems described above, which are particularly complex when biosphere reserves overlap with certain national parks.

1.29.2. France

France named its first biosphere reserves as early as 1977 and they remained undefined in French law for many years, until 2016 with the passing of the country's Reconquest of Biodiversity Act. They represented an on-the-ground embodiment of a scientific programme, the MAB programme, and international recognition.



Figure 6.3. Network of Biosphere Reserves in France (2020). Source MNHN.

MAB France is nevertheless associated with a number of biodiversity and protected area-related organisations. It is part of the Department for the Environment's national committee for biodiversity, and the national conference of protected areas, under the aegis of the National Office for Biodiversity ("OFB"). This office was created in 2018 with a broad approach to biodiversity conservation, and with links to society. This implies a stronger support for the MAB programme's approaches than previously, but which remains modest in relation to the stakes and the potential for developing the network.

Biosphere reserves also form part of the National Museum of Natural History's national biodiversity monitoring system (national inventory of natural heritage).

In practice, each biosphere reserve relies on one or more management or coordination mechanisms: protected areas, communities, associations. The reserves do not receive state or regional funding for their operation as such, but instead generally through their management structures.

Thus the delimitation of biosphere reserves follows several lines of thinking:

– either their perimeter is the same as that of their support structure. This is the case for the two national parks of the Guadeloupe archipelago and the Cévennes, governed by a 2006 law that puts the heart of the park within a local community membership zone, following a principle of ecological solidarity. The governance of the biosphere reserve is confused with that of the park (board of directors including institutions, local authorities, socio-professional representatives, associations, etc), and the management plan of the biosphere reserve is assimilated into the park's charter. It should be noted that the functions of the new generation national park are very similar to those of the biosphere reserves, as their layout includes two zones (not three): the core area of the park, which is regulated, and the membership zone;

- the same principle of overlapping perimeters, bodies and management documents (and functions) also applies to the Vosges du Nord (French part of the Franco-German transboundary biosphere reserve) and Mont Ventoux regional nature parks. Here again, they both function in very similar ways. Regional nature parks do not have a zoning system. They often include protected areas (nature reserves, other types of protection) on the biosphere reserve zoning is based.

These situations ensure stable funding and staffing.

– The Falasorma Dui Sevi Biosphere Reserve (extension of the Fango Biosphere Reserve in 2019) is a coherent and clearly identified sub-area in terms of the perimeter and management of the Corsican Regional Natural Park - in this case, its maritime façade. The decision-making structure is like that of the regional nature park, but also includes a management advisory committee that is specific to the biosphere reserve and represents its various stakeholders, along with a scientific council and a management policy that sets out specific objectives;

- the perimeter of the biosphere reserve has a geographical, ecological or sociocultural rationale that requires the collaboration of several structures that co-manage a coherent whole. This is the case with the Camargue (Rhone Delta) - one of the first French biosphere reserves (1977) following its extension in 2006. This is also the case for the marshlands of the Audomarois (the town of Saint-Omer and its marshlands), and islands and the Iroise Sea where a regional nature park and a marine park comanage the biosphere reserve. In all cases, each structure is the decision-maker within its territory and applies its own management policy. Cooperation work is defined for overall projects that relate to specific funding. In the Fontainebleau and Gâtinais Biosphere Reserve, a specific association is in charge of coordinating between the local authorities, regional nature park and associated associations. A scientific council is dedicated specifically to it;

- the large biosphere reserve of the Dordogne basin is based on a watershed approach. It is led by a public structure whose competences are related to the management of rivers and aquatic environments. This situation calls for the establishment of partnerships with other institutions or communities in order to ensure the range of projects required by biosphere reserves in terms of management (agriculture, forestry, economic development, urban planning, etc), education and so on. In the absence of specifically dedicated funding and support from the public authorities, the biosphere reserve struggles to broaden its partnerships sufficiently and ensure activities and presence across its immense territory;

- the biosphere reserve is larger than the perimeter of its support structure (Luberon-Lure, Mount Viso, Gorges du Gardon). This requires political agreements with neighbouring territories and these are not always formalised; at times, they give an indication of the extent of the support structures.

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	Date of designation	Coordinating organisation	Area (ha)	Population
Commune of Fakarava	1977 extended in 2006	Association of the Fakarava Biosphere Reserve	288,880	1500
Camargue (Rhone Delta)	1977 extended in 2006	Camargue Regional Nature Park, in partnership with the Mixed Association of Camargue Gardoise	160,000	From 110,000 to 220,000 (in summer)
Falasorma Dui Sevi Fango Valley	1977 extended in 2019	Corsica Regional Nature Park	23,500	450
Cévennes	1985	Cévennes National Park	325,000	50,000
Iroise Islands and Sea	1988 extended in 2012	Armorique Regional Nature Park and Iroise Marine Nature Park	200,000	1400
Northern Vosges Pfälzerwald	1989 transboundary since 1998	Vosges du Nord Regional Nature Park in France, Natürpark Pfälzerwald in Germany	310,300	337,000
Mont Ventoux	1990	Mont Ventoux Regional Nature Park	80,368	30,000
Guadeloupe National Park	1999 extended in 2013	Guadeloupe National Park	69,707	124,000
Luberon - Lure	1997 extended in 2009	Luberon Regional Natural Park	244,645	170,000
Fontainebleau - Gâtinais	1998 extended in 2009	Association of the RB of Fontainebleau and Gâtinais	150,544	267,665
Dordogne River Basin	2012	EPIDOR (Public territorial establishment of the basin)	2,400,000	1,200,000
Audomarois Marshes	2013	Caps et Marais d'Opale regional nature park and the Saint-Omer conurbation community	22,539	68,900
Mont Viso	2013 transboundary in 2014	Queyras Regional Natural Park Park of Po Cuneese	427,080	292,369
Gorges du Gardon	2015	Mixed Association of Gorges du Gardon	45,501	188,653

188,653

Table 6.3. Main characteristics of Biosphere Reserves in France.

The lack of own dedicated budget, coupled with these overlapping situations, make it difficult to raise the visibility of biosphere reserves in France. On the other hand, the diversity of institutional arrangements offers great flexibility of implementation. This provides real added value and allows adaptation to different issues and changes over time whilst offering spaces for dialogue in terms of coherent entities beyond administrative and political divisions. This is certainly the reason for new candidacies, even though the contribution of the "biosphere reserve" management model is little known and little supported by authorities (no public funding is currently allocated to a territory when it is designated a biosphere reserve). Along with this flexibility, its strong points include its networking, links to the scientific and educational world, international openness and UNESCO's reputation.

1.29.3. Morocco

Biosphere reserves seek to promote solutions beyond the network of protected areas in order to reconcile biodiversity conservation and its sustainable use (overall land-use concept) at national level. Morocco has been officially committed to a policy of creating state-of-the-art biosphere reserves since the beginning. This choice poses many implementation problems, as biosphere reserves' concept and governance models are still being debated at institutional level, 20 years after the first biosphere reserve was designated. The 1996 National Master Plan for Protected Areas led to the creation of a national network of protected areas that does not include biosphere reserves.



Figure 6.4. Map of biosphere reserves in Morocco (along with the network of protected areas included in biosphere reserves). Source: HCEFLCD, 2016.

Although not yet recognised under the legal framework, biosphere reserves are part of national and regional strategies to combat desertification and conserve natural resources that were promoted around 1995/2000 (for example, the Arganeraie and Oasis Biosphere Reserves in southern Morocco) with more recent strategies focusing on biological conservation being promoted since 2005 (the Intercontinental Biosphere Reserve of the Mediterranean and the Cedar Forest).

The governance of each biosphere reserve is different, with the Arganeraie biosphere reserve and Intercontinental biosphere reserve being the most active today. All follow the *authority model*, with governance in all cases being top-down and the managing body reporting to a government authority at regional level, and regional water and forestry directorates acting as catalysts.

Select committees are organised and coordinate several regional stakeholders. The Regional Directorate of Water and Forests and the Fight against Desertification ("DREFLCD") of the High Commission for Water and Forests and the Fight against Desertification ("HCEFLCD", Department of Agriculture, Fisheries, Rural Development and Water and Forests) is primarily responsible for nature conservation and forests, management of core areas, buffer zones and a large part of transitional areas. All forests are in the public domain and are under the responsibility of HCEFLCD, inside and outside protected areas. Management can become more complex in areas that are not considered forests, where HCEFLCD does not have direct enforcement authority. They are the responsibility of various sectoral authorities and the managing body is often obliged to negotiate and coordinate with other institutions to implement decisions.

The Regional Directorate of Water and Forests ("DREFLCD") is recognised as the managing body for biosphere reserves, with responsibility for the following:

- Implementation of the biosphere reserve strategy;
- Application of the biosphere reserve's development and management plan;
- Preparation of annual programmes;
- Activity planning;
- Preparation and signing of partnership agreements;
- Administrative and accounting management;
- Drafting of activity reports;
- Coordination at stakeholder level.

In addition, a network of local stakeholders is involved in making decisions about the future of biosphere reserves: local/regional authorities (municipalities and territorial communities), public authorities and institutions, professional sectoral organisations, universities and research institutions, NGOs and participatory body representatives of national parks located within the biosphere reserve. Its prerogatives are limited to the following:

 Examine and approve the management plan for the biosphere reserve submitted by the managing authority; - Make recommendations on any measure likely to improve the management of the biosphere reserve;

- Ensure coordination between the various stakeholders in the biosphere reserve and the coherence of their initiatives and activities.

The participatory body is chaired by the president of the regional council. An annual meeting is held at the request of the participatory body. In addition, the Regional Directorate of Water and Forests ("DREFLCD") provides the secretariat for the participation body.

In regard to administrative and management responsibilities, biosphere reserves operate on two levels: I) National level: the Natural Parks and Reserves Division of the HCEFLCD (High Commission for Water and Forests and the Fight against Desertification) in Rabat, which coordinates and supervises the national implementation of UNESCO's MAB programme, general issues relating to Moroccan biosphere reserves and governmental partnerships relating to biosphere reserves (for example: German cooperation on the Arganeraie Biosphere Reserve, French cooperation on the Southern Moroccan Oases Biosphere Reserve and Spanish cooperation on the Mediterranean Intercontinental Biosphere Reserve); II) Regional level: under which each biosphere reserve managing body deals with the mechanisms and sector policies for the different governmental and administrative stakeholders that map out their future.

1.29.4. Lebanon

The Chouf and Jabal Moussa Biosphere Reserves form part of the institutional landscape in different ways.

The Chouf Biosphere Reserve (including the Al-Shouf Cedars Nature Reserve) falls under the authority of the Lebanese Department for the Environment, which it manages via the Protected Area Committee ("APAC") and which is responsible for decision making and achieving the management objectives. APAC members are volunteers, appointed by the minister, representing local communities (town councils, district commissions), independent environmental experts, environmental NGOs and institutions (Department of Agriculture). The APAC liaises with the Biosphere Reserve team, which is responsible for day-to-day management and planning of the reserve. Other government agencies are involved other than the Department for the Environment: the Department of Public Works, responsible for the road that crosses it; the Department of Antiquities (antiquities and ancient ruins); the Department of Information; and the Municipality of Maasser Town Council (television transmitter), Barouk Water Board. The biosphere reserve needs the cooperation of all governmental and non-governmental sectors in order to achieve its goal of conserving the natural and cultural heritage of the region, while improving the well-being and income of the inhabitants of surrounding villages.

The management team is responsible for its operations (administration, management, technical and maintenance activities, protection, public awareness, communication and scientific research). It currently has 60 permanent employees and over 40 temporary employees, all of whom are residents of the Shouf region.

The Association for the Protection of Jabal Moussa ("APJM") - a Lebanese nonprofit NGO - manages the Jabal Moussa Biosphere Reserve. It stems from a number of cumulative international designations in addition to recognition by UNESCO, BirdLife Int'l (Global IBA), IUCN (example of best practices for Private Protected Areas), MedMAB, as well as the Lebanese protection labels of "Protected Forest" (Department of Agriculture), "Natural Site" (Department for the Environment) and "Protected Archaeological Sites" (Department of Culture).

The APJM is made up of an assembly of members (annual meeting), a board of directors (quarterly meeting) and a management structure that handles the day-to-day running of the reserve.

In 2012, the APJM made public its first ten-year sustainable management plan (supported by the Swiss foundation MAVA and the UNESCO office in Beirut) during an interactive conference involving academics, researchers, local elected officials, religious representatives, and the reserve's local village communities. This conference was the culmination of two years' work in cooperation with these same stakeholders.

The main management guidelines for biodiversity, culture and archaeology, university research and, above all, socio-economic development were defined as part of this conference and have been continuously developed and evolved together with an ongoing dialogue with the parties involved in the original 10-year plan.

The 10-year management and development plan is due to be updated in 2022.

1.30. Discussion

The UNESCO Biosphere Reserve model has received the strongest and most consistent support in Spain, where it holds an important and recognised place in the country's legislation and within institutions. There are numerous, visible sites and the network that they form is well-structured and organised.

The country invests heavily in international cooperation under the MAB programme. Spain organised three of the world conferences under the MAB programme and the biosphere reserve concept - notably in Seville in 1995, which produced the reference texts, Seville Strategy and World Network Statutory Framework. Spain also supports the IberoMAB network (Iberian Peninsula, Latin America) and more recently the Mediterranean Network of Biosphere Reserves.

In France, such a level of support has been - and still is - lacking. This is certainly explained by the similarity between the biosphere reserve concept and the French concept of regional nature parks, which were created in 1970. As of 2021, there were 56 of them. They are well-structured in a federation similarly to the biosphere reserves in Spain. To increase their international visibility, some have requested that UNESCO designate them as Biosphere Reserves.

The originality of the French MAB programme lies in being permanently aligned to the world of research. This has led to an original structure - the MAB France Association - which strives to strengthen the links between the scientific world and ecology as well as human and social sciences, higher education, and the biosphere reserves as areas for experimentation, in order to nurture an active transition towards greater sustainability. The strength of this association is the commitment of its members - a network of passionate, competent and committed people.

The result is innovative projects that are often insufficiently supported, structured and disseminated. Recent years have seen an improvement in its inclusion in the national landscape, as evidenced by the recognition of biosphere reserves in the 2016 legislation.

Adequate institutional positioning of the MAB programme is clearly lacking in the two southern Mediterranean countries. It is noteworthy, however, that the integrated approach advocated from the outset by the MAB programme (and formulated in the texts on which the biosphere reserves are based) are all reflected in legislation and practices across all countries: the link between conservation, development and land use planning; the need for support through training and education; and an understanding of the socio-ecological dynamics underway. Evidence of this is seen in the evolution of legislation on protected areas in Morocco and France's 2006 law on national parks.

It is clear that whilst the conceptual approach of the MAB programme and biosphere reserves has been disseminated, it has not sufficiently informed the public policies of certain countries. Biosphere reserves are still too often considered solely as international labels, with a lack of understanding of the richness of the concept. It is not easy to explain in detail what a biosphere reserve is. Furthermore, biosphere reserves suffer from having a name that is not readily understood by the general public.

These countries can draw on the more mature experiences from other countries, benefiting from the facility of the network.

Despite repeated warnings from the scientific world over the past 50 years along with a growing awareness in many countries, both locally and globally, the environmental emergency related to delays in limiting the biodiversity and climate crises are evidence of an insufficiently fruitful dialogue about protecting fundamental resources. More than ever, the MAB programme plays an important role in seeking to create interactions between worlds that are too often separated. Bringing together higher education and biosphere reserves and mobilising a younger generation that remains highly motivated by this 50-year-old programme, is a winning venture in terms of training, commitment and citizenship, the local management of territories, openness to the world, cooperation, and above all, the ability to tackle the profound changes to come.

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PART 2

Case Studies from Both Sides of the Mediterranean

Chapter 6

Emergence and Development of Mediterranean Biosphere Reserves in France:

Catherine Cibien

The Mediterranean region of France is the area most rich in biosphere reserves, boasting 7 of France's 14 reserves. These reserves are highly diverse, consisting of wetlands (Camargue), scrubland (Gorges du Gardon), Mediterranean foothills (Mont Viso) and medium to tall mountain areas (Luberon-Lure, Cévennes, Mont Ventoux and Falasorma Dui Sevi). Falasorma Dui Sevi is particularly significant due to its location on an island, Corsica.

This region of France is also where the first biosphere reserves were created in 1977, and they would go on to develop in terms of scope, governance and management with the arrival of the Statutory Framework of the World Network of Biosphere Reserves. As a result, these reserves also reflect how biosphere reserves and the ideas at the heart of the MAB programme have evolved over time.



Figure 7.1. Landscape of the Camargue Biosphere Reserve. Credit PNR Camargue.

The boundaries of the Camargue Biosphere Reserve were previously those of the Camargue Nature Reserve, managed by the French National Society for the Protection of Nature (SNPN, in French initials), which also included the Étang du Vaccarès lake. The reserve has no inhabitants, but the interaction between man and nature has still had a significant impact on the area. For example, the current delta wetlands of the Rhône, which has strong ecological potential, are the result of ancient human activity, such as diking, efforts to manage water levels and salinity, fishing, livestock farming and the cultivation of rice, vines and cereals. When the statutory framework was adopted in 1995, it was evident that the biosphere did not meet the required criteria and would need to be expanded. The initial site, having been awarded the status of national nature reserve, would become the core area of the future biosphere reserve. However, this expansion would also require the creation of a regional project around the nature reserve. Considering the existence of a regional nature park in the eastern area of the delta and other sites protected by other initiatives (such as Conservatoire du Littoral, Voluntary Nature Reserve, etc.), the project would require engagement with new stakeholders to develop an appropriate form of governance. MAB France played the role of mediator, inviting a group of key figures from the delta region (local politicians, representative professional bodies relating to agriculture, fishing, livestock farming, tourism, reed exploitation, protected areas, cultural associations, etc.) in a neutral location to decide whether to request that UNESCO withdraw Camargue's biosphere reserve status or expand the reserve to satisfy the criteria in the statutory framework. They chose the second option, and the proposal to expand the Camargue Biosphere Reserve to include the entirety of the delta was approved by UNESCO in 2006. Straddling two separate regions (Provence-Alpes-Côte d'Azur and Occitanie) and two departments, the eastern section of the reserve is managed by the Camargue Regional Nature Park and the western section is managed by a Syndicat Mixte, a public-private venture in the department of Gard. The biosphere reserve also has its own scientific council, and its management documents are those of the different bodies that have joined the initiative to develop various projects right across the delta (conservation, touristic, etc.), due to the undeniable geographic, ecological and cultural continuity throughout the area.

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Figure 7.2. Landscape of the Vallée du Fango. Credit Julien Innocenzi.

The Fango Biosphere Reserve was first recognised by UNESCO in 1977 following the submission of a short dossier drafted by scientists at the Association for the Ecological Study of the Maquis (APEEM, in French initials). This dossier sought to highlight the importance and exceptional nature of the oak forest, but it did not make a single reference to how the reserve should be governed or managed. In 1990, the biosphere reserve was expanded to include the entire Fango river basin. At this point, the "MAB Fango Committee" was created, bringing together the APEEM, the National Office for Forests (ONF, in French initials), who managed a good part of the forest, and the Regional Nature Park of Corsica (RNP) to discuss how the reserve should be managed. This committee is also supported by a management committee and a scientific council. The Fango Valley boasts strong geographic continuity and multiple points of ecological, cultural and historical interest. However, with just a few hundred rural inhabitants, it could hardly be considered a template for land management. During its periodic review, the decision was made to expand the reserve once more in response to UNESCO recommendations, and the RNP oversaw this process. The expansion of the reserve was linked to the renewal of the RNP's charter, and an effort was made to find synergies, with the charter being the current management document. It was finally decided that the biosphere reserve would cover the coastline of the RNP and also include the part of the coast designated as a UNESCO world heritage site. Recognised by UNESCO in 2020, the biosphere reserve changed its name (to Falasorma Dui Sevi), but it still preserves its scientific council and the management committee, which has defined a specific management plan.


Figure 7.3. High-altitude landscape of the Cévennes Biosphere Reserve. Credit J.-P. Malafosse.

The Cévennes Biosphere Reserve was created in 1985 with the hope of improving the reputation of a then maligned, inhabited national park with a strong cultural makeup resulting from historic interaction between man and nature. A comprehensive vision for the reserve and a balance between conservation and development was initially established, but a 1960 law on national parks did not cater for this. When the law was reformed in 2006, it was possible to improve the founding texts of the MAB and those of new national parks, and as a result, the scope, zonation, authorities and management policy were made more coherent.



Figure 7.4. Lavender fields in the Luberon-Lure Biosphere Reserve. Credit PNR Luberon.

The Luberon is one of France's oldest regional nature parks and is renowned for the way it is managed. The park sought to set itself new ambitions and gain an international reputation by becoming a biosphere reserve. Therefore, a scientific council and an active, structured educational service were established. During its first periodic review, in order to develop working practices and projects with communities to the east, on the Lure Mountain, the biosphere reserve turned out to be a well-suited, flexible framework for promoting collaboration. The reserve was therefore extended to include these communities and renamed the Luberon-Lure Biosphere Reserve.



Figure 7.5. Ariel view of the Gorges du Gardon. Credit SMGG.

The Gorges du Gardon is an exceptional site in the heart of the scrubland between Nîmes and Uzès. It is also home to the Pont du Gard bridge, a UNESCO world heritage site. Despite its beautiful biodiversity and important cultural heritage, this region has poor visibility, between Camargue and Cévennes. The region doubtlessly hoped to boost its reputation by becoming a biosphere reserve in 2014!



Figure 7.6. Education in the environment in the Mont Viso biosphere reserve. Credit Christophe Gerrer.

The Mont Viso Transboundary Biosphere Reserve is a mostly mountainous area, reaching an altitude of 3,841 m on the Italian side. Situated on the edge of the Mediterranean basin, the area's foothills feature more southern vegetation, and it forms part of the Provence-Alpes Côte d'Azur region at an administrative level. The French side consists of the Queyras Regional Nature Park, which oversees management of the reserve and the surrounding towns and villages. The biosphere reserve aims to build on and improve the historic collaboration between these groups and the Italian part of the reserve.

Chapter 7

Improving the Governance of the Mont Ventoux Biosphere Reserve

Ken Reyna, director of the regional nature park and coordinator of the biosphere reserve

1.32. Introduction

Key Details		
Country	FRANCE	
Name of Biosphere Reserve	Mont Ventoux	
Date of designation by UNESCO	1990	
Management Structure	Mont Ventoux Regional Nature Park	
Land Area	90,000 ha	
Population	83,500	

 Table 8.1. Key details for the Mont Ventoux Biosphere Reserve.

1.33. An iconic Mediterranean mountain

A true mixture of Mediterranean and Alpine nature, the Mont Ventoux Biosphere Reserve centres around the "Giant of Provence" and is notable for its biological characteristics. Mediterranean and Alpine habitats and species find themselves juxtaposed owing to the steep gradient in one part (1,909 m at the summit) and highly contrasting northern and southern slopes in the other.

In his *Souvenirs Entomologiques* (1879), Jean-Henri Fabre recalls the following: "Half a day moving along the vertical brought into full view a succession of the main types of vegetation that one would find on a long voyage from south to north along the same meridian. At first, your feet tread across balmy tufts of Thyme, which form a continuous carpet over the lower hilltops; a few hours later, they are treading across dark pads of Saxifraga, the first plant that the arriving botanist sees in July on the shores of Spitzberg ".

Mont Ventoux is a land of contrasts because of its altitude and its geographic location between the mild and Mediterranean climates. As a result, the mountain is

home to an amazing diversity of plant and animal species, including some that are truly rare.

1.34. Conserving and developing the assets of an exceptional region

Mont Ventoux's altitude range, contrasting environments and varied climate conditions have allowed a rich and remarkable flora and fauna to flourish. These include 150 species of nesting birds, 20 species of bat, 14 species of reptiles, 8 amphibious species, 2,500 insect species (including 1,425 species of butterfly), and numerous species of fish (particularly upstream). Furthermore, its bioclimatic stages have allowed 1,500 plant species to develop here, some of which are strictly endemic, like the *Acis fabrei*.

Mont Ventoux has also been the site of ancient human activity that has profoundly transformed the environment. Pastoral farming and the associated Mediterranean use of fire appear to be the cause of the first deforestations as early as the Neolithic. These practices intensified between 5000 and 4000 B.C. and continued through the Gallo-Roman periods and Middle Ages until the 19th century. At the end of the 19th century, significant reforestation efforts were made, and the forest grew with the planting of local species (such as Quercus ilex or Quercus Pubescens) and allochthonous species (notably Austrian pine and Atlas Cedar). The local economy changed and focused more on vines, lavender and cereals, and then arboriculture, market gardening and tourism.

1.35. A constantly evolving approach to governance

Mont Ventoux's designation as a biosphere reserve in 1990 led to the development of policy to protect and manage natural spaces and biodiversity. As a result, a number of different protection and management tools were progressively established:

- A complete state-owned biological reserve (906 ha);
- Six prefectural orders on biotope protection;
- Three Natura 2000 Special Areas of Conservation;
- Six sensitive natural areas.

A regional collective, a public-private entity focused on the development and facilities of Mont Ventoux, is in charge of the biosphere reserve. It is supported by a management committee composed of local politicians, economic and social stakeholders, members of environmental and cultural associations, etc. This committee plays an advisory role and is a place of discussion regarding the management of the massif, regional challenges, etc. The public-private entity, made up exclusively of local politicians, makes the final decisions (voting on budgets, action plans, etc.).

At the time of its creation, this institutional structure was very modern, with biosphere reserves more often being attached to protected areas. In the case of national parks, the development support function that they provided was largely absent, and in the case of regional nature parks, the international and scientific dimension was relatively weak.

The Mon Ventoux Biosphere Reserve undertook a series of parallel actions focusing on areas such as biodiversity and heritage (enhancing knowledge, monitoring programmes, management activities, etc.), eco-development (cycle-tourism, nature sports, eco-actors, bistrot de pays network, etc.) and education.

However, it should be noted that clear progress has not just been achieved in human and financial terms but also in terms of the intervention framework. Whilst the ambitions and functions of a biosphere reserve and a regional nature park (RNP) may appear to be the same, the major difference resides in the fact that the RNP is a tool of French law whereas the biosphere reserve has no equivalent and is considered to be an international label. Therefore, it can be difficult to guarantee the regular budget required to carry out its functions, and the legitimacy of its expression and interventions can easily be called into question.

As a result, the need for a comprehensive approach to conversation and development was recognised locally, and to address these issues, a regional nature park project was developed. It took nearly 10 years to set up and, from that point on, it would be the regional nature park that supports the Mont Ventoux Biosphere Reserve. This delivers the following advantages:

 A management policy (the charter of the RNP) that all collectives are officially engaged in for 15 years;

- Strong support from the state in the implementation of the regional nature park;
- Dedicated funding for RNPs.

From now on, the Mont Ventoux Biosphere Reserve relies on the regional nature park as a strong institutional and legal tool. Its precedence and above all, the regional debate and working methods introduced by the biosphere reserve, have been key assets in the creation of an RNP. The way that the two tools complement each other, their shared purpose, the reinforced legitimacy of interventions and the increasing involvement of stakeholders are equally important benefits for the biosphere reserve.

The action plan has also been strengthened by this arrangement, as well as the human resources involved in areas such as regulation (nature reserve plan, study on the establishment of a classified site around Ventoux, extension of prefectural orders on biotope protection, etc.), the management of natural areas (new sensitive natural areas, revision of Natura 2000 management plans, new scientific monitoring of natural habitats and species: grassy slopes, little owls, Egyptian vultures, etc.), public awareness (launch of community biodiversity map, etc.), and economic development (short food chains, comprehensive management of sports in nature: trail-running, mountain biking, cycling, hiking, climbing, etc.).

Chapter 8

Close-up on the Montseny Biosphere Reserve

Taken from the work Mediterranean Biosphere Reserve Network (*Réseau des réserves de biosphère Méditerranéennes*) (2019). Coord. Georgina Flamme, Roser Maneja, Jaume Marlès, Antonio Bontempi, Jorge Jesus Gracia, Mireia Corbera Serrajordia and Georgina Floguera. Fundación Abertis eds.

Key Details		
Country	SPAIN	
Name of Biosphere Reserve	Montseny	
Date of designation by UNESCO	1978	
Management Structure	Area de Territori i Sostenibilitat de la Diputaciò de Barcelona and Àrea de Medi Ambient de la Diputaciò de Girona	
Land Area	50166 ha	
Population	51,573 (2014)	

Table 9.1. Key details for the Montseny Biosphere Reserve.

The Montseny Biosphere Reserve has some of the highest levels of biodiversity in the entire Mediterranean basin, straddling three biogeographical regions, boasting a mixture of Western European landscapes and home to numerous taxa. Being very sensitive to current global changes, this is the area of choice for scientific research, whilst its cultural and historic values can be appreciated by all.



Figure 9.1 Monsteny in Autumn. Martí Boada.

Chapter 9

From the ecological quality status evaluation to the knowledge transferability. A cross-cutting experience in Montseny Biosphere Reserve

Sònia Sànchez-Mateo, Antoni Mas-Ponce, Roser Maneja

1.36. Introduction

Since the launch in 1971 of the Man and Biosphere programme (MaB), UNESCO promotes Biosphere Reserves worldwide as learning sites, living laboratories for the understanding of interactions between humans and their environments. Among their functions, the logistic support through research, monitoring, education and training plays a role of key relevance. The case of Observatori Rivus environmental monitoring and education programme is an exemplary case in point, as it embraces the MaB goals, embodies them in an innovative monitoring-education methodology and applies it in the Montseny Biosphere Reserve since 1996.

The long-term monitoring of the socio-ecological indicators of the quality status of the river basins inside the reserve informs and underpins an environmental education programme (PROECA) for the knowledge transfer to society under the motto "to bring back citizens to the river".

1.37. Mediterranean river basins as valuable and complex socioecosystems

Mediterranean river basins are mainly characterized by their inter-annual climatic variability. Drought periods in summer alternate to mild winters (Cuddenec, *et al.* 2007). Precipitations in these areas are linked to the seasonality, mostly in spring and autumn when flood episodes are more remarkable. This climatic variability will be more intensified due to Climate Change, the average annual temperatures on these areas are now approximately 1.5°C higher than the preindustrial period (1880-1899) and may be warmer in 2040 by 2.2°C (MedECC, 2019). Freshwater resources in the Mediterranean basin, considering a 2°C warming, will decrease by 2% to 15%, being the largest freshwater decrease in the world (Gudmundsson, *et al.*, 2016). In the specific case of Catalonia (North-East Spain) climatic models also indicate an upward temperature trend during the coming decades. From the period 1971-2000 to 2031-

2050, models indicate that the annual average temperature in Catalonia will increase by 1.4°C. Moreover, projections also show an annual rainfall decrease of 7% (CADS *et al.* 2017).

Historically, some of the Mediterranean fluvial systems become the core element of the society and the territory round them where most human settlements and infrastructures were strongly established during the 70's and 80's decades. Due to the intensification of these human activities mainly due to the increase of the population density, the Mediterranean region has suffered pronounced negative pressures and impacts on its environment (Blondel *et al.* 2010). Moreover, the fast industrialization process of these areas, profound economic changes taking place in that region led to a process of land abandonment in rural areas, especially in headwaters (Otero, *et al.* 2011; Sànchez-Mateo, *et al.* 2011; Voza, *et al.* 2015). These processes have negative effects on the freshwater ecological quality and the flow regime as consequences (Vega *et al.* 1998; Hermoso, *et al.* 2011).

1.37.1. The evaluation of ecological quality status

Water is an essential part of life; it is more than a mere resource. It has an ecological as well as a social function, so its protection and conservation is needed. The Water Framework Directive 2000/60/EC (hereinafter WFD) is the European regulatory framework that lays the groundwork for water management with a new focus on aquatic ecosystems as well as participation, incorporating citizens into decision-making.

WFD also establishes common bases for the integrated diagnosis of the quality status of water bodies from a physicochemical point of view, but also from a hydromorphological and biological perspective. And it urges the attainment of a good quality status.

The ecological status is the measure of quality of the functionality and the structure of an aquatic ecosystem. And a good ecological status is achieved when the biological communities are equal or close to those that are under unchanged conditions, and hydromorphological and physicochemical conditions should allow the proper development of these communities.

Climate, orography, soil, vegetation and human activities determinate the aquatic ecosystems characteristics: hydrology, chemical composition and water temperature, light gradient, habitat structure, biotic interactions (competence, depredation, etc.) and trophic resources availability. Aquatic organisms and those directly linked to fluvial systems are subjected to all these factors and so, they provide ecosystems' status information. In this sense, most of all the aquatic organisms can be used as fluvial systems indicators applying tested protocols and methodologies that permit mid and long-term monitoring to assess quality status.

1.37.2. Knowledge transfer and environmental education

Environmental Education is considered as an essential tool under the current context of global environmental crisis. In the last decades, since de second half of the 20th century and especially in the north-eastern area of the Mediterranean basin, the increase of human population density in urban areas, the settlement of industrial zones mostly concentrated along fluvial courses (Duran, 2018), and the construction of infrastructures with repercussions on the territory, among other factors, have led to a process of disconnection between society and their environment. This progression resulted in a general loss of knowledge and awareness with respect to the territory. In this context, environmental education strategies can contribute to reverse this process.

It was not until the First World Conference on the Environment organized by the United Nations in Stockholm (1972), when the Environmental Education and Communication concept was finally defined in an international level. This Conference was celebrated to discuss about the "The limits of Growth" elaborated by the Rome Club in 1972 which enhances the relevance of the negative effects of the current development model and with the main goal to find solutions to solve the environmental crisis.

The environment as a pedagogical resource was started to be used in Europe at the end of the 1960's and 1970's decade with the need to promote a social movement to face the general perception of the environmental crisis and to motivate an active education that promotes the direct contact with nature.

Some researches highlighted the importance of the experiences with the nature since for childhood to promote social and ecological awareness to face the distresses that alter natural dynamics and to increase the socioecological knowledge with respect to the environment (Corraliza & Collado 2013).

Observatori Rivus, a multidisciplinary applied research project leaded by Fundació Rivus and Autonomous University of Barcelona, aims to contribute to a reconnection between society and fluvial systems by the implementation of a knowledge transfer strategy through an environmental education, communication and training program, called PROECA.

1.38. Study area: Montseny Biosphere Reserve

Located in the Catalan Pre-coastal Mountain range, in the NE Iberian Peninsula, Montseny was declared as UNESCO Biosphere Reserve in 1978 under the purpose to achieve the necessary balance and synergies between society and the conservation of natural and cultural values.

It has a total surface of 50,166.63 ha divided into core zone (9,058.07 ha, 18%), buffer zone (22,914.00 ha, 45.7%) and transition zone (18,194.56 ha, 36.3%). The highest altitude is reached in Turó de l'Home peak, with 1,707m, followed by Agudes (1,706m) and Matagalls (1,693m). The Biosphere Reserve comprises 18 municipalities with a total of 51,573 inhabitants (Figure 2). The geographical location

of Montseny and the presence of three of the main biogeographical regions of Western Europe (Mediterranean, Euro-Siberian and Boreoalpine) confer to this area the range limit of different organisms and ecosystems, where northern and southern distributional boundaries for different species converge. This biogeographical uniqueness is exposed to global change and especially to climate change, becoming a very sensitive area in front of these processes and so considered as a sentinel landscape where applied and experimental research acquire remarkable relief.

Therefore, the Montseny Biosphere Reserve is one of the most emblematic natural areas in the region, where typical elements from a humanised landscape stemming from ancient times fuse with biogeographical values (Figure 3). Together with its proximity to the urban and metropolitan region of Barcelona, the ecological and cultural value confers to Montseny a great popularity that attracts a large number of visitors, being the service sector and touristic activities -above the primary sector, mainly related to livestock and forestry- essential for the socioeconomic of the region. Throughout the twentieth century, Montseny went through a significant transformation process due to energy changes associated with industrialisation, urban growth and a decline in the primary sector. Currently, the Montseny Biosphere Reserve also plays a noticeable role in the provision of environmental services and biodiversity conservation as well as in cultural and pedagogical activities linked to socioenvironmental awareness.

1.38.1. Observatori Rivus, a cross-cutting project in Mediterranean river basins

Observatori Rivus is an inter and multidisciplinary research project that aims to establish a set of indicators to carry out the evaluation of quality status through medium and long-term monitoring in Mediterranean fluvial systems, specifically in Besòs and Tordera river basins (NE Catalonia).

Thus, the research focuses on the monitoring and long-term registration of biological, hydromorphological and physicochemical indicators performed by different research areas where methodological protocols are developed and tested (Figure 1).

The long time series data obtained by Observatori Rivus project, started in 1996, facilitate the systematic assessment of the quality status of the fluvial system, essential for detecting changes in the studied period.

Moreover, the project develops and promotes knowledge transfer activities thanks to its own environmental education, communication and training programme (PROECA), launched for the first time in 2004. The main aim of this programme is to communicate the research results obtained to the general public, academics and policy makers alike. On the other hand, PROECA fosters to contribute improving the relationship between fluvial systems and society. Connections to enhance this engagement are established by means of participative initiatives, approaching people to the river and involving participants in the application of methodologies for quality indicators assessment. From the ecological quality status evaluation to the knowledge transferability. A crosscutting experience in Montseny Biosphere Reserve 87



Figure 10.1. Organizational structure of Observatori Rivus, highlighting PROECA as the key tool for knowledge transfer and dissemination.

1.38.2. Sampling units

Observatori Rivus develops its tasks in the Besòs and la Tordera river basins (NE Catalonia), including part of the Montseny Biosphere Reserve considering headwaters and mid courses of la Tordera, Gualba, Breda and Arbúcies streams, all of them belonging to la Tordera river basin; and Vallforners, l'Avencó and Congost streams in the Besòs river basin (Figure 2 and Figure 3).

Three sampling units are determined in order to comply with the methodological protocols related to the above-mentioned monitoring areas:

- Stretches: defined by the sections in which a river course is divided under a criterion of homogeneity in terms of their physical characteristics and their degree of naturalness or disturbance. Most stretches are coincident with water body masses defined by Catalan Water Agency. These sections contain the other two types of sampling units: transects and stations, both of them used as basic monitoring units;

– Transects: defined as longitudinal sections along the river being representative of the stretch where they are included. Their longitude is comprised between 500 meters and 3 kilometres, in accordance to the requirements for each research area protocols and methodologies. Avifauna, riparian vegetation (quality of the riparian forest), mammals and amphibians and aquatic reptiles are monitored in transects;

– Stations: defined as specific and punctual sampling units suitable for the methodological application of macroinvertebrates, diatoms, fishes, hydrology, amphibians and aquatic reptiles (HDP: high diversity ponds) and riparian vegetation (flora inventories) research areas.



Figure 10.2. Map of the Montseny Biosphere Reserve displaying the sampling units of Observatori Rivus.



Figure 10.3. Riparian areas in the Montseny Biosphere Reserve. From left to right

and from top to bottom, headwaters of la Tordera in La Castanya valley; headwaters of Gualba stream in Santa Fe valley; two images of la Tordera in headwaters areas dominated by riparian forests with alder (Alnus glutinosa) and common ash (Fraxinus excelsior); la Tordera in the mid-course; and Arbúcies stream.

1.39. Research areas

Observatori Rivus project focuses on eight research areas for biological, hydrological and physicochemical monitoring. Each of them follows a specific methodology based on validated protocols and different campaigns are performed throughout the year in order to evaluate intra-annual variability in relation to the abundance and composition of communities.

1.39.1. Biological monitoring

1.39.1.1 Diatoms

Benthic diatoms, given their microscopic size and high reproduction rate, respond sensitively and quickly to changes in their environment, so that they reflect the impacts that occur at the micro and mesoscale. Therefore, these microscopic algae are very good bioindicators of variations in the physicochemical quality status of water and the biological quality of rivers. Due to their microscopic nature, alterations in the physical characteristics of the river (variations in water flow and velocity or changes in the granulometry of the riverbed) affect them to a lesser extent than in other organisms such as macroinvertebrates.

Through the evaluation of diatoms, the aim of this research area is to determine over time and space the quality of water in river courses from the specific diversity of benthic diatom communities using the IPS index (Gomà, 2005; ACA, 2006).

1.39.1.2 Macroinvertebrates

The benthic macroinvertebrate community is one of the most widely used bioindicators historically to determine the biological quality of river and stream water (Rosenberg and Resh 1993) and it is currently one of the quality elements that are part of monitoring and control programs in the whole European community, following the guidelines of the WFD. Sampling protocols, biological indices and their quality ranges according to each type of river are defined by the Catalan Water Agency (ACA, 2006).

The methodology consists in the collection of biological samples of macroinvertebrates from the sampling units established for the determination of the biological quality of water with biological indices (IBMWP, BMWPC and FBILL). The fluvial habitat index (IHF) is applied complementarily to evaluate the general conditions of the complexity of the habitat in Mediterranean rivers, closely related to the biological indices.

1.39.1.3 Fish

Fish tend to occupy high trophic levels (Sánchez-Hernández & Amundsen 2015) and are relatively easy to sample and to identify. In general terms, their absence indicates limitations in the ecological status in the study area (Lorenz *et al.* 2013), so this group has often been used as indicator of the health for the aquatic ecosystems. In addition, they are well known by the general public and become an excellent communication and environmental management tool (Simon 1999; Benejam *et al.* 2008a; García-Berthou *et al.* 2016).

The use of biotic water quality indices based on the composition of fish communities is a common practice, so the WFD has selected fish, together with macroinvertebrates and diatoms, as indicators of ecological status in relation to biological monitoring.

The fish research area Observatori Rivus uses the IBICAT2b index (García-Berthou *et al.* 2016) to determine the ecological status of the sampling units. In addition, the analysis of the composition and amount of species captured during sampling enables to determine the diversity and distribution of the species.

1.39.1.4 Birds

The general objective of the bird research area is to study the temporal evolution and the specific composition of the nesting riparian birds of the river courses as bioindicators of quality status. This is a pioneering initiative as birds are not covered by the WFD in the assessment of the quality status of water bodies.

In this sense, the project aims to establish a sampling protocol in order to specify the bioindicator character during the breeding season of the different bird species by crossing the abundance indices obtained with other factors. These factors include land cover and land use, variables from the sampling of other research areas comprised in the project, or parameters related to the ecology of each species, such as its distribution, abundance or its degree of threat.

The method used for the evaluation of birds is based on the establishment of linear transects with bands, which allow to calculate the detectability (through auditory and/or visual sensory detection) and to estimate the abundance, taking into account the value of detectability, by applying the distance sampling method (Voříšek *et al.* 2008).

When evaluating trends over the years, the oscillations of some key or bioindicator species have been studied, especially aquatic birds which are sensitive to environmental alterations, for example the bluefin (*Alcedo atthis*) or the blackbird water (*Cinclus cinclus*), among others.

1.39.1.5 Mammals

In the last years this research area is focusing on the development of an otter monitoring program with the objective of surveying the return of this species and evaluating its presence and population structure in the study area. The otter is a reliable bioindicator of the recovery of the socioecological quality of fluvial systems. The study and population analysis of this mustelid has implications on the management and conservation of riparian ecosystems, as well as it plays a key role for social awareness and citizen science initiatives.

The European otter (*Lutra lutra*) has a wide natural geographical distribution, being a key piece in the ecological balance of river ecosystems. From the second half of the twentieth century, the otter suffered a sharp decline in much of Europe. By 1990 it had disappeared from almost all of Catalonia, except in some areas of the Pyrenees. This decline was in response to anthropogenic alteration of river ecosystems, and especially to industrial pollution and its effects on trophic availability (Ruiz-Olmo 2011). From the mid-1990s, the situation improved with the implementation of water treatment measures, and the species has recovered by returning to much of the basins where it had disappeared, including the Besòs and Tordera basins and in the area of the Montseny biosphere reserve.

Faced with this new scenario-recent, dynamic and difficult to imagine a few years ago- it is highly relevant to carry out a study that combines the monitoring and analysis of the current situation of this species.

The objectives of the otter monitoring are to analyse and document different aspects of the ecology of the species that are decisive for its establishment and breeding in different sections of recent recolonization. This includes the analysis of the suitability of the habitat, the study of the diet and the determination and evaluation of its distribution.

1.39.1.6 Amphibians and aquatic reptiles

Amphibians are interesting as bioindicators due to their complex life cycle requirements: the presence of aquatic habitats for reproduction and larvae development, as well as a proper terrestrial habitat for their adult life. Moreover, this group is particularly sensitive to global change, becoming a good indicator of environmental changes (*Petitot et al.*, 2014; Boada *et al.* 2008).

The main goal of this research area is the evaluation of richness and abundance of the different amphibian and aquatic reptile communities in river courses and adjacent ponds. This evaluation provides information about ecological status, environmental disturbances in fluvial systems and surrounding water bodies, and trends in populations that are being threatened in the last years due to emerging diseases in amphibians. For this reason, biosecurity procedures are adopted in the monitoring protocols.

The applied methodology is based in auditory censuses (night-time call count and visual encounter) to detect and to identify species by male calls during spring, in the reproductive period. A listening point is set every 100 meters along a 500 meters transect in the river course, where species identification and number of individuals assessment is conducted during a three minutes period. Moreover, adjacent ponds with high diversity are also evaluated (HDP). In addition to this method, a visual sampling of aquatic reptiles is also performed to detect the grass snake (*Natrix natrix*), the viperine water snake (*Natrix maura*), Mediterranean pond turtle (*Mauremys leprosa*),

European pond turtle (*Emys orbicularis*) and non-native species such as the common slider (*Trachemys scripta*).

In reference to anuran, nine species are considered: the Iberian green frog (*Phelophylax perezzi/Phelophyax kl. grafi*) -which is the most abundant-, the Mediterranean treefrog (*Hyla meridionalis*), the European frog (*Rana temporaria*), the common midwife toad (*Alytes obstetricans*), the parsley frog (*Pelodytes punctatus*), the common toad (*Bufo spinosus*), the painted frog (*Discoglossus pictus*) -a non-native species which population range is expanding-, the natterjack toad (*Epidalea calamita*) and the Iberian spadefoot toad (*Pelobates cultripes*). The species of urodelans in the study area are the common fire salamander (*Salamandra salamandra*), the marbled newt (*Triturus marmoratus*) and the palmate newt (*Lissotriton helveticus*).

Deserve mention apart the populations of Montseny newts (*Calotriton arnoldi*), located in specific areas in the headwaters of the Montseny Biosphere Reserve. This endemic species is considered critically endangered (CR) by the IUCN, becoming one of the most endangered amphibians in Europe with specific conservation programs.

1.39.1.7 Riparian vegetation

Riparian vegetation, developing in humid and productive soils along the course of rivers and streams, is an essential element of study in assessing the ecological status of river systems.

The role of riparian forests in the dynamics of riparian ecosystems can be defined from a multifunctional point of view, as they have hydrological, ecosystem, landscape and economic implications. The WFD establishes, in Annex V, the quality indicators for the classification of the ecological status, one of which is characterized by the composition and abundance of the aquatic flora.

This research area carries out the assessment of the richness of plant species, their abundance and the hydromorphological structure of the riparian area. Medium- and long-term monitoring of these parameters contributes to the detection of trends in the quality status of riparian ecosystems.

Vegetation inventories are carried out by applying the phytosociological or sigmatist method of Braun-Blanquet (1979), assessing the diversity and abundance of the flora present in three strips of the riparian area: river channel, bank in the ordinary floods area and bank in the large floods area. Non-native species are also considered in the inventories, especially invasive species, as biological invasions are one of the most important components of global change and one of the major threats to conservation for native species according to the International Union for Nature Conservation (IUCN). River systems favour the dispersal of species, including exotic flora, capable of establishing in altered habitats.

1.39.2. Hydromorphological monitoring

Hydromorphological monitoring considers the hydrological regime (flow volume, piezometric levels, maintenance flow rates, alteration of the hydrological regime), river continuity and morphological conditions based on the assessment of the riparian vegetation (QBR index).

Observatori Rivus proposes the use of percentiles in relation to the maintenance flow for the assessment of the quality of the annual hydrological regime, using daily averages data.

In relation to the analysis of riparian vegetation as factor for evaluating the riparian area from a hydromorphological point of view, the QBR index is applied as a metric. The QBR (Riparian Forest Quality) index assesses the quality of the riparian forest and the degree of alteration of the riparian zone in four independent blocks: degree of riparian cover, vegetation structure, quality of the cover, and naturalness of the river channel (ACA, 2006).

1.39.3. Physicochemical monitoring

The organic load or total organic carbon (TOC), salinity (concentration of chlorides and conductivity) and eutrophication (concentration of ammonium, nitrates and nitrites) are evaluated. There is also a chemical water quality assessment based on the analysis of factors such as temperature, pH, oxygen concentration, alkalinity, sulphates, chlorides, calcium, magnesium, sodium, potassium, iron and manganese.



Figure 10.4. Images of some research areas sampling and methods. From left to right and from top to bottom: sampling of macroinvertebrates and identification of

taxa in the laboratory; research of the amphibians and aquatic reptiles; applying biosecurity protocol for material disinfection; electric fishing demonstration; phototrapping technique for otter monitoring.

1.40. Environmental Education, Communication and Training Program

Under the premise that rivers are an excellent educative resource, the main principle objective of PROECA is to transfer scientific knowledge obtained from the different research areas to different spheres of the society by implementing an environmental education and communication strategy. The information flow is thought as bidirectional, as local knowledge obtained by interviews or participative processes to key actors and local experts is also taken into consideration and is integrated in the applied research that has been described in the previous sections.

Thus, the environmental education and communication strategy aims: to promote the dissemination of the results of the project using different channels in accordance with the targeted audience; to generate social interest in relation to fluvial systems; to encourage participation; and to promote the discovery of cultural and natural fluvial heritage.

Three scopes are addressed to three main spheres:

– Social: the values of the natural heritage as well as their status of conservation, management practices and the historical and social uses of water are promoted. In this direction, one of the goals of the program is the development of pedagogical materials aimed at different levels of education (primary and secondary) linked to the research areas. These materials, presented during guided fieldtrips to rivers and streams near to the educative centre, are designed with the main goal of translating and disseminating protocols of monitoring methodologies and the results obtained to the teaching staff and students;

In terms of general public, communication materials are also produced, such as travelling exhibitions, leaflets or digital contents and audio-visual materials. Moreover, participative sessions are also promoted. The presence in media and social networks is also part of the communication strategy of the project.

 Scientific: the project aims to exchange and disseminate methodologies for the establishment of a monitoring model for river quality status indicators assessment that could be extrapolated to other Mediterranean basins;

In the academic scope, the programme includes the training of students and researchers who are undertaking internships, postgraduate studies, masters or doctorates from a wide range of different disciplines.

– Political and governmental: the information obtained is synthesized into annual reports which are disseminated to enhance territorial planning and integrated management of water resources in the decision-making processes. The educational processes that are contemplated in the different scopes according to the target audience, are mainly developed in <u>three areas of action</u>: formal education, non-formal education and informal environmental education. Thus, based on the different fields of action and the target audience, PROECA develops an environmental education strategy that aims to provide elements for a reconnection of society with its closest fluvial environment (Figure 5).

1.40.1. Formal education

It is developed in the school and academic context. The main objective of formal education corresponds to promoting the learning of various areas of knowledge from the use of didactic and pedagogical materials adapted for each educational level.

1.40.2. Non-formal education

It contemplates the transmission of knowledge, skills and environmental values outside of the institutional educational system. It entails the adoption of positive attitudes towards the natural and social environment, which are translated into actions of care and respect for biological and cultural diversity and that promote intra and intergenerational solidarity. It is recognized that environmental education is not neutral, but rather ideological, since it is based on values for social transformation (Declaration of the Land of the Peoples. Foro Río 92 in Castro and Balzaretti, 2000). Non-formal education is carried out outside the curricular contents through organized and systematic activities focused on solving specific learning needs and directed to groups or subgroups of the population.

1.40.3. Informal environmental education

It considers actions aimed at training, informing and reflecting on environmental issues through the media such as publications, radio, television or cinema (González 1995 in Castillo 1999).



Figure 10.5. Scheme of PROECA strategy. Source: Maneja, R. (2010).

1.41. A 15 years period implementing PROECA in the Montseny Biosphere Reserve

A data compilation of PROECA activity from 2004 to 2019 shows that up to 101 activities have been conducted in 10 municipalities in the Montseny Biosphere Reserve (31,25% of the total) with 4.786 participants, including scholars and citizens. Overall, there is a clear relationship between the amount of activities and engagement (Figure 6, Table 1).

Municipalities	Participants	Activities
Sant Celoni	2113 (44,15%)	57 (56,44%)
Arbúcies	860 (17,97%)	17 (16,83%)
Santa Maria de Palautordera	733 (15,32%)	15 (14,85%)
Breda	430 (8,98%)	3 (2,97%)
Montseny	360 (7,52%)	2 (1,98%)
Riells i Viabrea	154 (3,22%)	1 (0,99%)
Gualba	60 (1,25%)	1 (0,99%)
Sant Esteve de Palautordera	46 (0,96%)	3 (2,97%)
la Garriga	25 (0,52%)	1 (0,99%)
Figaró-Montmany	5 (0,10%)	1 (0,99%)
TOTAL	4786	101

 Table 10.1. Total number and percentage of participants at the PROECA activities from 2004 to 2019.

Out of the approximately 4786 participants in the 101 PROECA activities, 1690 are part of the public audience group and 3096 are scholars. In that sense, there is a clear difference in the attendance between the two audiences, although the number of activities destined for both audiences is significantly different (62 activities for public audience and 39 for scholars) (Figure 7). It must be taken into consideration that the total number of participants is underestimated, as the number of visitors of exhibitions, among other non-guided activities, is difficult to count and is approximate.

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Figure 10.6. Map of participation at PROECA activities for each of the municipalities of the Montseny Biosphere Reserve in the period 2004-2019.



Figure 10.7. Total number and percentage of participants at the PROECA activities from 2004 to 2019.

Data reveal that over the years, PROECA activities attracted more scholars than the general audience. Future schedules in the program need to be focused in fostering a better participation of citizens in order to be able to fulfil the objectives of the PROECA and strengthen the relationship between the inhabitants of the Montseny Biosphere Reserve with their own fluvial systems.



Figure 10.8. Images of environmental education activities with scholars, guided fieldtrips and conferences addressed to general audience.

1.42. Conclusions

Observatori Rivus proposes a cross-cutting experience that encompasses a wide range of activities related to the concept of Biosphere Reserve as a 'learning laboratory for sustainable development'. From scientific research for the assessment of the environmental quality status of the Montseny Biosphere Reserve basins, the program aims to transfer knowledge to society through the implementation of an environmental education strategy.

Transferability has been recently implemented from Tordera to Besòs river basin and it could be replicable also in other Mediterranean territories. In a context of an increasingly informed and empowered society for contribution at the level of research and management, the Observatori Rivus and PROECA experiences demonstrate Biosphere Reserves are also suitable scenarios to encourage participation processes and the promotion of citizen science.

As biosphere reserves are considered as science for sustainability support sites, in other words, special areas for testing interdisciplinary approaches to understanding and managing changes and interactions between social and ecological systems, this proposal could become of interest to replicate mid and long-term monitoring research linked to environmental education and knowledge transfer in relation to fluvial systems.

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Chapter 10

Close-up on the Menorca Biosphere Reserve

Taken from the work Mediterranean Biosphere Reserve Network (*Réseau des réserves de biosphère Méditerranéennes*) (2019). Coord. Georgina Flamme, Roser Maneja, Jaume Marlès, Antonio Bontempi, Jorge Jesus Gracia, Mireia Corbera Serrajordia and Georgina Floguera. Fundación Abertis eds.

Key Details		
Country	SPAIN	
Name of Biosphere Reserve	Menorca	
Date of designation by UNESCO	1993	
Management Structure	Menorca Biosphere Reserve Agency for Menorca Island Council	
Land Area	514,485 ha	
Population	95,000	

Table 11.1. Key details for the Menorca Biosphere Reserve.

Menorca is the most easterly island in the Balearics. The biosphere reserve covers the entire landmass of the island and a large marine area, including the natural park of S'Albufera des Grau. All of the townships in this inhabited region, with its traditional rural landscape, are involved with the biosphere reserve. The diversity of Mediterranean habitats is remarkable, including ravines, caves, pits, wetlands, dunes, islets, small hills and mounds and vast open rural spaces. Its archaeological and historical heritage is exceptional, with more than 1,500 archaeological finds.



Figure 11.1. Naveta des Tudons. Credit S. Sanchez.

Chapter 11

Jabal Moussa Biosphere Reserve (Lebanon): A Private Association Initiative

Pierre Doumet and Joelle Barakat

1.45. Introduction

Key Details		
Country	LEBANON	
Name of Biosphere Reserve	Jabal Moussa	
Date of designation by UNESCO	2009	
Management Structure	Association for the Protection of Jabal Moussa (APJM)	
Land Area	6,500 ha Core area: 1,250 ha	
Population	Approx. 8,500	

Table 13.1. Key details for the Jabal Moussa Biosphere Reserve.

1.46. Rich by nature

"The Jabal Moussa massif is an elevated natural area, known for its walks and hiking trails through landscapes that are not commonly found in Lebanon. The summit is particularly beautiful, featuring sinkholes and jagged crests, large gatherings of European hop-hornbeam, maple and ash, Turkey and Aleppo oaks, mighty Syrian junipers, clearings and ancient terraces. The northern slope also hides some stunning surprises, with Turkish pine forests, ancient coal sites, sheer cliffs, streams bordered by large plane trees... and a walk from Ebré to the most easterly point is particularly enjoyable ." This was the conclusion of a detailed report written by the French National Office for Forests (ONF, in French initials), funded by the European Union on behalf of the Lebanese Ministry of Agriculture at the end of the 1990s.



Figure 13.1. Landscape of the Jabal Moussa Biosphere Reserve, Abraham River.

At the request of the Association for the Protection of Jabal Moussa (APJM), the Ministry of Agriculture agreed to award the area protected forest status in 2006. This was followed by its designation as a biosphere reserve by UNESCO in 2009.



Figure 13.2. Zonation of the Jabal Moussa Biosphere Reserve.

The impact of climate change on the forest and species that live there, as well as the quantification of the goods and services provided at the heart of the protected area, have been studied as part of a Mediterranean project by the French Facility for Global Environment (FFEM, in French initials) (Daly Hassen 2016), for which the biosphere reserve is a pilot site in Lebanon. Having measured this, research has then been undertaken into the ways of managing and optimising goods and services (ecotourism, facilities, apiculture, training for women in the sale of products, etc.). A study by Poyatos *et al* (2016) in collaboration with the APJM and the Lebanese Ministry of Agriculture highlighted the positive impact of the protection measures put in place by the APJM since 2007, noting an increase in dense forest areas as well as changes in the NDVI reflecting changes to the health and density of vegetation.

Research carried out on resident and migratory birds in the region (Demopoulos 2008), involving a field study over many months, concluded that Jabal Moussa is deserving of the status of Global Important Bird Area (according to the criteria of BirdLife International).



Figure 13.3. Long-legged Buzzard, buteo rufinus.

A study on mammals by Abi Said (2012) revealed the "quiet" presence (visible in the daytime rather than exclusively at night) of iconic mammals such as the wolf and the hyaena, as well as 21 other mammals, in sufficient numbers to give hope of being able to repopulate the surrounding nature reserves.

One on-site expedition by Finnish entomologists (Kurina *et al.* 2015, Zeller *et al.* 2016) discovered two endemic insects that are only found at Jabal Moussa (including *Micropterix Jabalmoussae*).

In 2012, two famous figures in Lebanese biological and ecological studies, Georges and Henriette Tohmé, published two papers *Fleurs* and *Arbres du Jabal Moussa* and concluded that the region was home to 726 types of plants, including 24 which are endemic to Lebanon and 6 solely to Jabal Moussa. A recent study as part of a joint international project between the CEPF (*Critical Ecosystem Partnership Fund/AFD*), two Lebanese universities (USJ, LAU) and the Jabal Moussa Biosphere Reserve more specifically illustrates the interaction of locals, visitors and researchers.



Figure 13.4. An example of the exceptional flower Pentapera sicula libanotica. Credit G. & H. Tohmé.

1.47. A biosphere reserve run by private initiative

The biosphere reserve is governed by the APJM, a non-profit NGO, whose managing council consists of local and national figures. The organisation boasts a young and dynamic local team that undertakes numerous conservation and sustainable development projects funded by national and often international donors. Given the

mix of landowners within the reserve, including townships (community rights), religious institutions (waqf) and private individuals, it would be natural to include these parties in the governance of the biosphere reserve. However, because of the disparity of interests between these parties, it was more practical for APJM to engage with them in the form of lease agreements specifying the land usage in accordance with the objectives of the MAB programme. Therefore, mayors and other elected officials, religious representatives and certain private individuals each play a more sporadic role, having given APJM the authority to manage their property according to the principles of MAB/UNESCO.

It should be noted that Jabal Moussa did not benefit from any protection before the creation of the APJM. Given the numerous levels of protection obtained by the APJM (protected forest, natural site, archaeological sites, etc.), the relevant ministries (agriculture, environment and culture) should, in theory, also form part of the biosphere reserve's governance.

In practice, contact with these bodies tends to be sporadic because, having been initially canvassed by APJM to agree to the various levels of protection, these institutions have, today, a number of other concerns. As a result, their visits mainly related to celebratory events, inaugurations and project close-outs to satisfy themselves that work is being carried out correctly and that the area's natural and cultural heritage is being continually enhanced.

The APJM is made up of an assembly of members (annual meeting), a managing council (quarterly meeting) and a management structure that takes care of the day-today running of the biosphere reserve.

In 2012, after two years working with various institutions, the APJM presented their first 10-year plan for sustainable management (supported by the Swiss MAVA foundation and UNESCO Beirut), as part of an interactive conference involving academics, researchers, local officials, religious representatives and local communities from the villages in the reserve.

1.48. International recognition

The APJM is responsible for a number of international designations issued by UNESCO (biosphere reserve), BirdLife Int'l (Global IBA), IUCN (example of "Best Practices" for PPA-Private Protected Areas), MedMAB, as well as the Lebanese statuses of "Protected Forest" (ministry of agriculture), "Natural Site" (ministry for the environment) and "Protected Archaeological Sites" (ministry of culture).


Figure 13.5. Archaeological excavation of a tomb.

1.49. Management focused on socio-economic needs

The management of the biosphere reserve is mainly focused on biodiversity, knowledge of cultural and particularly archaeological heritage, academic research and, particularly, socio-economic development. These key areas have underpinned the evolution of the biosphere reserve's governance and form part of a continuous dialogue with the parties involved in the initial 10-year plan.



Figure 13.6. Valuing local products.

To analyse the impact of the APJM's 10-year plan on the main villages in the biosphere reserve and evaluate the perception of the inhabitants of the core area, the APJM has compared two surveys carried out ten years apart, one in 2009 and the other in 2020 (Roula Abi Habib Khoury, in press). This information would then be used to inform the new 10-year plan planned for 2022. The comparison of the two surveys showed that the biosphere reserve is currently perceived to be a significant employer and that the initial feeling that the reserve was "encroaching on liberties" has become much less prevalent. The concept of ecotourism is now very well understood and largely accepted, with annual visitors having grown from 300 to 30,000 between 2009 and 2019. This is due to the number of jobs created, including direct employees, guides, wardens, guest houses and producers of local products. Young people (direct employees and guides) and women (guest houses and local products) have been the main groups to benefit. A section of the population still continues to claim their rights of unlimited access, for both legal and illegal activities, whilst another is concerned about the spread of wild animals. However, even in 2020, the year of the COVID-19 pandemic, the number of visitors exceeded 40,000 as many families opted to visit nature areas.



Figure 13.7. Numerous walking routes attract visitors, such as this Roman footpath.

All the meetings held over the years with village mayors and local inhabitants have reinforced the following conclusion: against a backdrop of general decline and increasing economic problems, the socio-economic benefit for the area is clear. Local participation has therefore been mainly driven by a desire to direct eco-tourism and buyers of local products towards their particular village.

Apiculture and the harvesting and preparation of thyme have become increasingly more popular among the locals. These products (sold under the Jabal Moussa label) are distributed nationally and enjoy a growing reputation. Production standards are

very strict, and preparation of these products (as well as similar products like jam and handcrafts) takes place in a central, well-equipped workshop or kitchen.

Plants produced by the nurseries in Jabal Moussa, with seeds from the biosphere reserve, enjoy a strong reputation with the two main national reforestation bodies and are therefore highly prized. The APJM is one of the most recent additions to the CNTPL (Cooperative of Native Tree Producers of Lebanon), and reforestation of the reserve is both selective and progressive.

1.50. Efforts to raise awareness and education about the area's exceptional biodiversity

Jabal Moussa and the surrounding area has been designated a "Key Biodiversity Area" (KBA) by the Critical Ecosystem Partnership Fund (CEPF), partially informed by an investigation by BirdLife International. The national study by CEPF revealed that the Jabal Moussa/Adonis Valley KBA had the highest score in Lebanon due to its strategic management focusing on plants in critical danger of extinction or that have very restricted areas of distribution.

The CEPF also funds a project to conserve Lebanon's endemic flora through community engagement, which also involves the APJM, Saint Joseph University in Beirut (USJ) and the NGO Friends of Nature. This project includes the Jabal Moussa Biosphere Reserve as it is known for its endemic species, such as *Cyclamen libanoticum*, *Erica sicula libanotica*, *Salvia peyronii* and *Paeonia kesrouanensis*.

Its aim is to raise awareness about endemic, indigenous and unique species in Jabal Moussa and the surrounding area. Activities have been carried out in collaboration with Friends of Nature and Saint Joseph University, such as evaluations of the conditions of species on the ground and botanical training for members of the APJM. Work has been undertaken to develop a plan to better conserve the flora in the reserve and develop awareness-raising tools for the community through education: herbarium, botanical garden, mobile app, social media campaigns, etc.

The research carried out in the Jabal Moussa Biosphere Reserve has focused on two key areas:

In-situ conservation, which consists of working locals and visitors to identify and map Jabal Moussa's endemic floral species and evaluate their status in order to establish conservation actions;

- *Ex-situ* conservation, which involves the creation of germination protocols for endemic species. Once established, these protocols will enable the APJM to propagate these endemic species in nurseries for native species.

It is important for the APJM to relay this information to the public through the awareness-raising activities that it carries out with local communities and visitors to the biosphere reserve:

 A welcome centre ("The Budding Botanist") for schoolchildren and botany enthusiasts, which includes an exhibition of certain floral species, a special herbarium for the biosphere reserve and an activities room;

 This centre is close to three nurseries for native plants, where visitors can observe the process of propagating native plants from seeds and participate in planting activities;

- An area named "The Biosphere Garden" at the entrance to the reserve, where visitors can walk around, rest and learn more about botany by observing existing species in the garden or native species introduced by the APJM (such as a series of cyclamens, including the endemic *cyclamen libanoticum*), so that visitors can learn to distinguish them from others, or a population of zaatar (*origanum syriacum*, a culinary herb which is highly prized both locally and nationally);

- A botanical trail featuring signs displaying the name of the plant and a QR code leading to more information through a mobile app;

- An awareness-raising campaign on social media about the importance of endemic species.

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Chapter 12

Architecture and the biosphere environment in pedagogy: design visions for sustainable dwelling communities

Carla Aramouny

1.52. Introduction

Architecture today must evolve out of the bounds of its immediate built limits to extend into environmental surrounds and must concern itself more holistically with questions of natural preservation and sustainable development. Through design, architects need to inherently address questions related to the natural environment, and the integration of building and landscape, while promoting sustainable strategies that not only tackle the performance of the built structure but also extend to its natural context and community. In areas of biosphere reserves, especially in buffer zones, architectural development should involve conceptual, formal, behavioral and programmatic strategies that can support and connect to the extended community of the biosphere, through communal projects that integrate sustainable living, working, and connecting to the natural terrain. In this paper, I will address the pedagogical experiments of engaging with the biosphere reserve of Jabal Moussa in Lebanon, through the work of 3rd year architecture students at AUB. The paper will discuss the pedagogical methodology, the contextual framework of Jabal Moussa, and select design visions that try to imagine potential sustainable housing community that can work symbiotically with the biosphere. As such, the work presented here reflects on the necessity to address biosphere reserve areas through architecture in a holistic sustainable approach moving beyond the limits of the built form to encompass usage, integration, material, and the extended natural and human environments.

1.53. Architecture and the Environment

The work presented here starts from the premise that architecture today must work in synergy with nature and must perform symbiotically with it to enhance the performance of the built environment. Rather than reducing architecture to only its spatial and programmatic capacities, we need to rethink and redesign a more sensible and productive architecture that can link to its natural context and incorporate active environmental functions, thereby synergistically contribute to better both the built and natural environments. This is enabled by incorporating in the design process a deep understanding of the natural environment, its behaviors and environmental conditions,

and to establish the possible synergies that can happen between the human habitat and the natural habitat in a non-intrusive sensible manner. As such, and within this studio, the question of the natural environment in Lebanon is tackled through the particular focus on integration with biosphere reserves and their surrounding community through design, programming, and environmental performance.

The concern for architecture's extended impact on the environment, has been growing more urgently in recent years in the field, especially the larger impact of the built on our natural resources extending beyond the bounds of the building itself the to the larger urban and territorial scales. Moving beyond the aspects of environmentally responsive solutions at the building scale, the intersections of the built environment with the natural environment at large need to be tackled from a more holistic ecological perspective, where both entities form a material, operational, and social continuity. As such the natural and built environments should be considered as forming a single and sensible ecology.

In his text "After Habitat, Environment", Hadas Steiner¹ describes an evolution of the understanding of habitat, or the enfolding (natural or built) environment sustaining life, within contemporary architecture discourse. Referring to Conrad Waddington's work in the 1960s, he describes the latter's understanding of environment as a hybrid between technological/physical and natural interactions, between various ecologies and organisms.

"This shift away from the language of habitat to that of environment, from regional territory and biology, to global informational networks, was thus marked by a loss of binary opposites as those between natural and social, open and closed systems, city and country."

The shift towards recognizing environment as a larger encompassing dynamic field intertwining both the man-made and the natural led, according to Steiner, to a habitat-based model of urbanism since the 1940s, bringing forth the idea of "ecology" as model for conceiving and understanding the built environment in synergy with nature. James Corner² further elaborates on the ecological model in design as a dynamic organizational system that encompasses both landscape and architecture in flux and continuous feed-back with one another.

The biosphere reserve in general presents an interesting condition of intersection between natural habitats and human habitats, between a natural reserve protecting particular ecosystems, and the human and communal habitats intersecting with it. The biosphere reserve as a condition thus brings forth this ecological model of co-habitat,

¹ Steiner, Hadas. "After habitat, Environment" in Ibañez, Daniel, Katsikis, Nikos; "New Geographies 6 : Grounding Metabolism", Harvard University Graduate School of Design, 2014, pp. 88-97.

² Corner, James, "Organizational Ecologies", in Belanger, Pierre, "Going Live: from States to Systems", Princeton Architectural Press, 2015, pp. 76-77.

where human, animal, built and natural environments work synergistically. In Steiner's essay he refers to the work of evolutionary biologist Julian Huxely, who defined three ecological scales of interaction in habitats from the large climatic and regional scale, to the topological or terrain scale, to the biotic or immediate biological scale. The biosphere reserve involves these three ecological scales of habitat through its core, buffer, and development areas, where interactions and feed-back become key to sustain the life of the biosphere reserve.

Using this ecological model of understanding, our design studio approach was to work with nature and the biosphere of Jabal Moussa in particular in a more integrative manner. The projects developed by the students tackled the integration of new architectural interventions, specifically for housing communities in the buffer area of the biosphere, that could have a synergistic engagement and a more responsive attitude towards the natural environment.

1.54. Jabal Moussa Biosphere reserve and the studio's premise

The studio focused on the Jabal Moussa Biosphere reserve in Lebanon as an area of research and was developed in collaboration with the Nature Conservation Center at AUB, where architecture design and pedagogy became agents to engage students with biosphere reserves in research and conception.

Biospheres reserves in general are protected extended environments that integrate natural, social, and cultural heritage, while supporting adjacent communities and people. Under the program Man and Biosphere developed by the UNESCO, the Jabal Moussa Biosphere reserve was granted its status as a preserved area in 2009³. It is a mountainous area surrounded by seven villages between the Keserwan and Jbeil districts, with a rich natural biodiversity from flora and fauna, to cultural heritage and ruins dating back to Roman and Phoenician periods. The reserve further incorporates eco-tourism through its hiking trails, guesthouses, in addition to local produce markets and a tree nursery. Through its different aspects, the reserve relies on and supports the adjacent local communities, from villagers in the region who work in it, to the establishment of guesthouses, small eateries, and villagers' kitchen. The Jabal Moussa biosphere reserve is formed out of three zones, the core natural zone, the buffer area including towns such as Qehmez and Mchati on its southern edge, and the larger development or transitional area including further villages and towns.

The studio recognized the biosphere reserve of Jabal Moussa as a valuable zone that enables regional development, and that has the potential to integrate new programs, especially in its buffer areas through an engagement between the central natural core and the outer development and peri-urban areas. The students were asked to imagine architectural interventions in the buffer areas around the reserve, to incorporate viable housing strategies that reshape the possibilities for sustainable

³ Jabal Moussa website: https://www.jabalmoussa.org/reserve.

domesticity. The idea was to incorporate new communal models for living and working, close to these natural zones, and away from the polluted urban areas, allowing inhabitants to escape from the mundanity of suburban housing into a communal living that reconnects them back to nature. Furthermore, these eat-livework communities would support the reserve and enhance the connection between peripheral urban areas and the close-by villages. The preferred sites for such interventions were selected in areas within the buffer zone that are within proximity to dense urban environments, as the project aims to propose viable autonomous communities that can serve as the link between the biosphere reserve and suburban centers. The chosen sites included upper and lower parts of the village of Qehmez and the village of Mchati near the Nahr el Dahab river.

1.54.1. Studio Methodology and Research in 3 scales of operation

Based on the previously mentioned ecological model, the studio methodology was developed through three main scales of research, understanding, and design operations:

- The Biosphere reserve scale / Engage: The first scale is that of the entire biosphere and includes a proactive engagement with it through rigorously understanding its conditions and learning about its mechanisms and the potential for architecture and people to contribute further to its livelihood.

- The habitat scale / Perform: This involves the scale of the habitat and its integration with the immediate contextual and climatic conditions of the site for the housing project, by enabling the architectural space to react, behave, and operate in symbiosis with the outside environment.

- The human/organism scale / Activate: The third is that of the community, where the research focused on enabling new socio-cultural user interactions, communal activities and supporting programs that benefit and synergistically connect with the towns and the biosphere environment.

1.54.1.1 The Biosphere reserve scale: Engage through a proactive approach

This first scale involved deep understanding of biosphere reserves in general and focused on the Jabal Moussa context and its surrounding villages of Mchati, Qehmez Plateau (upper), and Qehmez Valley (lower). Through in-depth research, mappings, and analysis, the students gained thorough knowledge of the context within which their architecture projects could be imagined. Their investigations of the area were approached from different perspectives but focused generally on climatic and environmental factors, local ecosystems, spatial typologies, and socio-economic realities.

The research used available resources from books, references, and online information and maps. However, to understand the site more intimately, a hiking and weekend trip was organized with the Nature Conservation center's support for the students and professors to engage directly with the biosphere. The group visited the biosphere area and explored it through the different walking trails, and spent time in the local nearby towns and their available facilities from the eating houses to local small markets. They also interacted with the local community to help formulate a clearer picture about the intersections of Jabal Moussa with the community surrounding it.

The students' research tackled different aspects of biosphere reserves in general and the Jabal Moussa biosphere reserve in particular. They understood biosphere reserves first as the rich ecosystem and life-sustaining layer on Earth that forms the habitat of all living creatures, living together in symbiosis. The UNESCO Man and Biosphere program moves from this premise to identify and protect rich biosphere around the world, that designate a particularly rich biodiversity, community integration, and cultural and natural heritage, while enabling economic and sustainable development. Each biosphere is structured along three interrelated areas: the core, buffer, and transition zones. As one of the 33 UNESCO Biosphere reserves in the Arab World, Jabal Moussa is understood as a particularly rich landscape and community, home to protected species and local cultural heritage, and engaged with 7 surrounding villages. It is a mountainous area in the Keserwan district of Lebanon (Figure 1), bound by two rivers and covering an area of 6500 hectares, at an altitude ranging between 350 meters and 1,700 meters⁴. It includes a rich ecosystem ranging from riparian in the valleys to open woodland in the mountainous area, with varied and unique flora and fauna. In its forest area, it includes species such as Oak, Juniper, Pine, and wild Apple trees, in addition to various types of wild orchids and endemic plant species such as the cyclamen and the Lebanese oregano. Jabal Moussa is also an important migratory bird habitat, and bottleneck for migratory routes, with bird species such as eagles, storks, and sparrow hawks (Figure 2). Different species of wild animals also inhabit Jabal Moussa, such as the striped hyena and wild boar, with some particular to the Middle east region and Lebanon like the rock hyrax (Figure 3). The students in their research further understood different climatic conditions in the area, from wind direction and speed in different seasons, sun orientation, and varying humidity levels (Figure 4). Additionally, they looked at socio-economic and biointegrated programs that form part of the richness of Jabal Moussa, from recreational eco-tourism activities, to medicinal plants, honey making and local food produce (Figure 5).

⁴ "A Walk through Jabal Moussa", MAB Med 2015, PDF online, viewed on https://www.jabalmoussa.org/sites/all/themes/jabalmoussa/img/walk-through.pdf.



Figure 33.1. Jabal Moussa Biosphere reserve in Lebanon (Lea Tabaja, Yara Haidar, Noura Bissat).



Figure 33.2. Flora, Fauna, and migratory birds (Lea Tabaja, Yara Haidar, Noura Bissat).

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Figure 33.3. Wild animals of Jabal Moussa (Myriam Abou Adal, Marc Faysal, Amir Moujaes).



Figure 33.4. Wind speed, seasonal flows, and local villages (Myriam Abou Adal, Marc Faysal, Amir Moujaes).

Furthermore, they zoomed in to select areas around the villages of Mchati at Nahr el Dahab and Qehmez (upper and lower sections of the town), to understand in more depth their various environmental and social characteristics. The upper plateau of Qehmez was understood as a productive agricultural plain with links to Jabal Moussa through a main entrance into the reserve, and proximity to local guesthouses and the tree nursery (Figure 6). The lower section of Qehmez in the valley, was also understood a rich agricultural area with tomato plantations and affected by a direct proximity to local uncontrolled quarries (Figure 7). The area featured traditional single unit house typologies, with terraces and vine shaders in connection to the agricultural fields. The village of Mchati was also researched and understood as a town that is adjacent to the Nahr el Dahab river. Featuring a series of terraced zones on the side directly adjacent to the steep slopes of the biosphere, Mchati includes many direct supporting programs to Jabal Moussa, from a local produce market, to a guesthouse and eatery that engage with visitors to the biosphere (Figure 8). Architecture and the biosphere environment in pedagogy: design visions for sustainable dwelling communities 123



Figure 33.5. Local activities and bioeconomic potential (Joseph Chalhoub, Aya el Husseini, Baraa Al Ali, Samer Abboud).



Figure 33.6. Qehmez plateau (Joseph Chalhoub, Aya el Husseini, Baraa Al Ali, Samer Abboud).



FROM HUMAN TO NATURAL SYSTEMS

Figure 33.7. Qehmez valley (Myriam Abou Adal, Marc Faysal, Amir Moujaes).



Figure 33.8. Village of Mchati (Lea Tabaja, Yara Haidar, Noura Bissat).

1.54.1.2 The Habitat scale: Perform through environmental responsiveness and housing

The second scale of the studio process involved understanding environmental behavior and site conditions as extensions of an architectural space through a design

process of abstract physical models. The environment and climatic conditioning of an architectural building were looked at in depth within this studio. Inspired by works of architects like Philip Rahm, the approach involved understanding climatic and atmospheric conditions, from heat, wind, humidity and others, as dynamic flows that are implicated by the form and spatial parameters of an architecture project.

"The aim is to conceive an architecture free of any formal and functional predetermination: variable, fluctuating, open to meteorological permutations and the passage of time, to seasonal changes, to the alternation of night and day and moreover to the sudden appearance of unanticipated functions and forms."⁵

To start conceiving of their model experiments in relation to climatic conditions, the students narrowed into a site of their choice in one of the three selected villages. They began conceiving of an architectural spatial intervention that can foster good climatic and sustainable synergy with its site and context. The students understood through further research issues such the site's materials and landscapes, its orientation, as well as wind and energy flows, sustainable materials, passive design strategies, and typological integration with landscape.

The design process used to achieve this focused on developing physical experimental models at a scale of 1/20. The models were developed as abstract spaces that intersect environmental behaviors and performance with architectural typologies. Drawing upon specific site conditions from wind direction, sun orientation, and others, the students each created and imagined a space that optimizes climatic behavior while creating an interesting architectural and landscape experience. Accordingly, each produced model intersected three main parameters:

- Natural elements: the space in the model should help enhance or reduce the behavior and flows of natural climatic elements, such as heat, cold, air and wind circulation, rain, and humidity.

- Architectural Typology: the form of the model should start from specific spatial typologies (such as courtyard, tower, elevated mass, or other) that can optimize or transfer these natural flows. The selected typologies should also provide a meaningful spatial experience

- Context: The architectural model should also articulate or respond to a condition of the site, such as a tree or landscape species, a water feature, a rock formation, or another locally found characteristic.

Each of the students' models thus provided a climatic concept and formal approach that allowed them later to design a more developed housing scheme. Moving from

⁵ Rahm, Phillip, "Form and Function follow Climate", AA Files, No. 55 (Summer 2007), Architecture Association, London, pp. 2-11.

these abstract experiments into housing typologies, each of the houses designed by the students became thus a spatial result that intersects site issues, with landscape, and climatic behaviors. This abstract experimental phase allowed the students to understand architectural space and form as a parameter that controls climatic energy flows and enables certain levels of comfort and shelter. It also allowed the students to factor in spatial experience and living atmosphere while critically solving climatic needs. (Figures 9-11)



Figure 33.9. Climatic model. Joseph Chalhoub.



Figure 33.10. Climatic model. Omar Ayache.

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Figure 33.11. Climatic model. Lea Tabaja.

1.54.1.3 The Human/organism scale: Activate programs & community engagement

In the third scale of research within the studio, the students moved on to develop and propose potential programs and communities, which could be imagined to relocate to the vicinity of Jabal Moussa. Based on their in-depth site research, each of the students delved into their own programmatic proposal, foreseeing a new type of community living and working and supporting the biosphere. The proposed program served as a link between the incoming inhabitants and the local area and its people, and as a potential communal and sustainable space that can link to existing synergies and resources in the different towns. The students relied on their investigations of local services, the different towns, their resources and produce, in addition to currently existing synergies between the biosphere reserve and the villages, to propose new types of programs that can be situated in the proposed housing community and that can engage with the biosphere reserve and villages.

For example, one of the students had looked at existing economic potentials in the village of Mchati and found that honey making can be a good source of production due to precedents in the area. The student's new programmatic proposal centered around beekeeping and honey production through a community including beekeepers and researchers, living together and co-producing honey to be sold through the biosphere reserve's shops and markets (Figure 12).



Figure 33.12 Honey making community program. Joseph Chalhoub.

Another example looked at a program on a site near Qehmez that can seasonally house local nomad shepherds, who m ove yearly between the Bekaa valley and Jabal Moussa vicinity. The proposal combined communal dwellings for three shepherd families with local eco-tourism, including play areas and camping sites, food production, agricultural zones, and farmers market (Figure 13).



Figure 33.13 Shepherds and eco-tourism. Omar Ayache.

A third example considered the possibility of integrating in Mchati a hybrid program that can support the biosphere while also supporting particular people in need. The idea was to combine a nursing home for the elderly with a children's orphanage, while integrating and supporting food production and farming practices. Connecting to existing terraces and vines, the program instigated a connection between the elderly/ children community to nature, agriculture, and the biosphere (Figure 14).



Figure 33.14 Housing for elderly and children. Lea Tabaja.

1.54.2. Student architectural proposals and results

Following up on these different scalar investigations, from site research, climatic model experiments, to programmatic proposals, the students moved then to develop their architectural proposal for the dwellings, by first starting with an individual housing unit to accommodate a single individual or a family. The design of each of the housing units relied on the programmatic needs of their proposed program and users, in addition to climatic behavior, spatial experience, and internal connectivity.

Each design of the house had to establish a clear relationship to the outdoors and the natural site, and to involve a sensitive integration with the landscape and local materials. From the design of the unit, the students then moved to develop strategies to combine the individual units together to form communal clusters and agglomerations, and to conceive of their overall community scheme including additional production and recreational areas. Within the communal agglomeration, the houses needed to interact together both spatially and socially, as they respond to site, climatic, and programmatic conditions.

Different student projects developed out of the semester, each approaching the three scales of research uniquely, and resulting in varied design visions that cross communal housing with environmental integration and biosphere synergies.

The first project focused on the socio-economic potential of the area, and in the village of Mchati specifically, through incorporating a productive community interacting with the biosphere through honey making. Developed by student Joseph Chalhoub, the project for the community housing and honey production facilities is developed as an integrated architecture within existing terraces on the Mchati slopes, facing the river and adjacent to Jabal Moussa's lower entrance. In his proposal, Joseph focused on designing first a single housing unit that sits within the slope, and that relies on his earlier physical models to design large southern openings and ventilation flows that optimize the climatic conditions of the unit. To create the community, he went on to cluster each two houses together, centered around a shared outdoor landscape, with all the other clusters aligning to different levels of the existing terraces. A central communal outdoor area links the inhabitants of this community together. The community would maintain beehives in close-by lots adjacent to the biosphere and uses their communal and production spaces at the lowest end of the development, to produce honey as an important local produce. The design also makes use of local stone materials and local plants and agricultural to create a holistic and productive environment. (Figure 15)

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Figure 33.15. Integrated community dwellings and honey production. Joseph Chalhoub.

A second project by Omar Ayache focused on embedding architecture within the natural landscape and on supporting existing vulnerable communities in the vicinity of Jabal Moussa. Omar started by working on an existing rocky area in Qehmez, with varied geological formations. In his first part investigating humidity and the resulting formation of underground cavities through erosion, Omar experimented with different relationships between heat and humidity transfer, and conditions of height and width of subterranean spaces. His intervention involved casting and creating clay layers with vertical inlets within the artificial rock, allowing it to erode and develop spaces and cavities in time with varying heat and humidity levels. This new rock formation would merge together with the site's natural limestone and form well-conditioned spaces over time. His previously mentioned program that crossed housing and shelter needs for local shepherds also included local and visitor programs, from a farmer's market, to guesthouses and camping sites. The program was situated within the architectural cave-like space following geothermal factors and comfort needs, ranging from higher warmth to lower humidity levels. Housing three families of shepherds mainly, the

community would thus revolve around the interaction of the shepherds, the local farmers, and local tourists to the biosphere and the area. The design itself is formed out of the natural process of erosion and is created as a multileveled house, where each room is positioned according to heat and coolness factors. The houses also open up to and connect to one another through communal areas and meeting zones. (Figure 16)



Figure 33.16. Embedded geological dwellings for local nomads. Omar Ayache.

The third project by Lea Tabaja focused on evolving a new hybrid community integrated on the agricultural terraces of Mchati, on specifically on a zone with existing vine climbers. Her project began through complex studies of intersecting surfaces on a slope, which could optimize cross ventilation and heat transfer. The existing vines on the site created an underlying grid that guided Lea's decision on where to intervene. Her program proposed that a group of elderly would move to and live in a housing community that also includes a children's home. The two groups, the elderly and children, would live within the same community, sharing intersecting spaces, from eating areas to gathering zones, while also having separate functions such as private bedrooms, reading and playing rooms. They would thus inhabit together this communal dwelling while engaging with the adjacent biosphere and the local village. The design of the housing units started from the earlier formal and climatic experiments, and then evolved to incorporate programmatic needs and slope requirements. Each unit is designed as part of a dual cluster, with two homes engaging together with different types of supporting spaces. The programs were positioned relative to individual and common functions, and also based on the users' day /night activities and comfort needs. Sleep spaces for example coincided on similar private sides within the cluster, while more active play or activity areas happened in more open and connected spaces to the outdoors. The existing vines on the slopes further enabled an outdoor / indoor productive connection to landscape. (Figure 17).



Figure 33.17. Hybrid architecture and existing landscape terracing. Lea Tabaja.

The fourth project by Myriam Abou Adal focused on an environmentally responsive architecture and proposed that a group of botanists would relocate to Qehmez to experiment and research on the different species in the Jabal Moussa area. The botanists would live together in this sustainable community, where the work and living programs intersect and meet. Different outdoor agricultural areas and indoor greenhouses form part of the community and engage directly with the houses and lab

spaces. The design of the housing units, and then later the clusters, were focused on an optimized indoor climatic performance with protection from harsh sun rays, while enabling thermal heat absorption by the walls and planted roof. Good cross ventilation and vertical stacking of spaces also allowed a continuous hot air flow throughout the space. The planted roofs further served as outdoor meeting areas and productive landscapes that serve the users. From a macro perspective, the entire community was designed to engage with the rocky site of Qehmez, while following the constraints of the slope, and intersecting architecture with landscape and infrastructural needs. The common areas included outdoor agricultural zones, a walking / exercising track connecting all the units, and a water collection system that provided for water needs in summer. Common supporting programs also included waste composting and a seed bank that would serve as an educational facility to incoming visitors. (Figure 18)



Figure 33.18. Productive housing clusters and the environment. Myriam Abou Adal.

1.55. Conclusion

The studio thus worked on bringing research and understanding of biosphere reserves right into the heart of the architectural studio, and to position it as an essential subject that students could engage with to propose more holistic and sensitive integrations of integrate architecture with environment. The biosphere itself served as a model of reference, as an ecology that includes necessary synergies between people, the natural environment, in all its encompassing richness from the ground layers to the atmosphere. Architecture as such as was seen and developed as a continuity of this ecosystem, and as an inherent synergistic space that engages with its surrounding and community. Through a scalar research methodology, that moves from the scale of the biosphere, the habitat, to that of the community, the work developed in this studio allowed students to design novel intersections of architecture and the environment, and to propose new visions for housing communities.

Using research, visualization, and experimental climatic models, the students were able to develop their projects as potential alternatives to urban or rural housing typologies, and to cross sustainable design strategies with productive landscapes. The aim overall was to develop new architectural ideas that can be situated in the buffer areas of Jabal Moussa and that could become crucial supporting programs to the life and development of the biosphere.

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Chapter 13

Balancing Conservation and Sustainable Regional Development: Lessons Learnt from the Second 10-year Assessment of the Arganeraie Biosphere Reserve

Abdel Aziz Afker and Said Boujrouf

1.57. Introduction

The Arganeraie Biosphere Reserve is a large area on the western coast of Morocco and has become an open-air laboratory for observing various changes and developments. These changes are the result of different interacting factors linked to economic, social and cultural innovation, adaptations, the effects of globalisation and various environmental developments. The history of the Arganeraie Biosphere Reserve teaches us a lot about the complexity involved in regional governance and how to face up to the, sometimes, competing challenges of conservation and sustainable regional development. Following its designation as a UNESCO biosphere reserve, the second periodic review has more recently shone a light on how the region has changed in both time and space. Once a decade, UNESCO casts a verdict on the state of the biosphere based on an assessment of its current situation. The first report was established for the period between 1998 and 2008, in which the biosphere reserve maintained its UNESCO status. In 2018, a new report was produced that included more elements and comparative measures than the standard model that was used previously.

What lessons can we draw from this second evaluation? What changes have occurred in terms of conservation and sustainable regional development against a backdrop of climate change and local development needs? How can a balance be struck between the public policy of decentralisation, implementation of SDGs and the different levels of public action? Is the Arganeraie Biosphere Reserve a regional project or just a brand? How much weight should be given to either conservation or development?

1.58. Conservation and sustainable regional development: reconciling the irreconcilable?

The argan tree regions of Morocco are today undergoing a profound transformation towards a new reality and find it difficult to adapt to the UNESCO biosphere reserve concept. This new standard requires a general review of fundamental knowledge and concepts to best frame and translate the current changes into scientific representations and interpretations.

Today, more than ever, the biosphere reserve is seeing the degradation of its soil, its drainage basins, its biodiversity and its hydrographic potential. The effects of human activity can be seen everywhere. Climate change and other global changes are having a significant impact here. Even if "the specific values of biosphere reserves and the opportunities that they represent with respect to climate change were recognised in the Madrid Action Plan for Biosphere Reserves (2008-2013) and the Dresden Declaration on Biosphere Reserves and Climate Change (2011)"¹, the biosphere reserve still finds itself having to address complex and growing environmental changes without any effective tools. The involvement of different stakeholders and, particularly, the inclusion of the local population could help contribute towards making the region more resilient and improving "conservation and sustainable management of biodiversity that forms an integral part of sustainable development" (OECD 1998). As a result, we will consider how the biosphere has moved from strict conservation and the condemnation of farming practices towards the involvement of "local communities" in the conservation of spaces and species (Wells *et al.* 1992)² to ensure that regional development is as sustainable as possible.

The commitment of stakeholders is achieved through development processes and the granting of heritage status. This, in turn, is achieved by mobilising specific resources as a result of receiving some form of general recognition, such as the UNESCO designation in 1998, or specific recognition such as the Protected Designation of Origin for argan oil made law in 2008.

Development, particularly of tourism, goes hand in hand with the granting of heritage status for cities like Agadir. This relationship between development and international recognition of the biosphere is a big problem (Gravari-Barbas, Bourdeau, Robinson 2012) and is the result of economic effects and a true "race to labelling" (Duval and Smith Benjamin 2014). In fact, labelling not only becomes a way of justifying the discourse and practices around environmental protection (Tommasi, Richard and Saumon 2017) but also of reinforcing regional involvement and the rehabilitation of resources (François, Hirczak, Senil 2013) that become not only regional resources but part of regional heritage (Boujrouf 2014).

¹ UNESCO, 2017, A new Roadmap for the Man and the Biosphere (MAB) Programme and its World Network of Biosphere Reserves, UNESCO Publishing, 27 mar. 2017 - 58 pages.

² Quoted by Martin J.Y. *et al.* 2002, Développement durable : Doctrines, pratiques, évaluations, Paris, IRD Editions, Page 187.WELLS *et al*l., 1992.

While general or specific labels can contribute to the creation of a regional brand and local identity, normalisation can begin to touch the system of specification and risks eroding these achievements. There is a need to demonstrate that regional product labels protect local knowledge (Boisvert, Caron 2010), particularly given the strong deviations observed across the different areas of the biosphere reserve.

These trends increasingly cross over with the profound changes taking place, creating a dichotomy of regions, traditional versus modern, the provokes significant emigration from more marginal areas and great resistance from pockets of poverty (El Fasskaoui 2009; Faouzi 2017). As result, these juxtapositions evolve towards the creation of new social figures bringing about the destruction of family agriculture (Lacombe 2015) at a time when we should be moving towards innovation and resilience to bring back agro-ecological sustainability and sustainable regional development.

1.59. Complexity of issues and adaptation for a resilient balance

The Arganeraie Biosphere Reserve is a vast region of strong contrasts and fragile balances between semi-arid and weak arid areas. The climate, particularly with respect to rainfall and temperature, varies greatly and is linked to socio-economic vulnerability. This large region also boasts diverse heritage connected to culture and local knowledge.

Depending on the resource and its levels of usage, the problem of erosion can vary greatly. A significant surface area is threatened by water erosion as the result of irregular rainfall, poor vegetation coverage and the primarily rough terrain. Wind erosion is also a problem because of the sensitive sandy substrates and strong winds in certain areas. These effects are worsened at a local level by overgrazing, nature and the transformation of farming techniques. The irregular and often weak seasonal rains often lead to scarce water resources. In the terms of utilised space, the dominant crops are essentially cereals, but this brings in little local revenue (bour) and remains dependent on the climate. In fact, nearby forest ecosystems compensate for these lands during drought periods. Furthermore, the significant differences in terms of location (upstream/downstream and east/west) also have an important impact on local development.

The delicate nature of the land is also coupled with large-scale socio-economic problems (poverty), the impetus of rapid local development in inhabited areas and the degradation of regional ecosystems. All of this demonstrates just how vulnerable the region is and how significant the risks to nature really are.

At the same time, the physical settings and types of ecosystems found here, combined with the way in which resources are used, create a form of stratification which makes it possible to identify homogenous regions where certain interventions could be feasible. This stratification can be further fine-tuned by considering previous experiences, particularly with regard to technical planning and project management.

The period between 2008 and 2017 could be described as a period of great change where challenges that closely impacted the region's development were clearly brought to the fore.

During this period, four years brought rain (2010 and 2011 were quite exceptional) whilst the remaining years were dry. This led to the emergence of new phenomena in the reserve, particularly the frequency and size of forest fires. Between 2011 and 2012, the average number of fires increased from 14 to more than 100 per year. There was also a large-scale increase in herds of dromedaries and sheep (by the thousands) arriving from neighbouring regions, and these herds greatly disrupted systems of production through overuse.

This fluctuation in rainfall from year to year has not only had a significant impact on conservation efforts but also presented challenges for ecosystems to naturally readjust and re-establish equilibrium. As a result, annual programmes have been implemented by numerous organisations (particularly the Department of Water and Forests) to conserve ecosystems, soil and biodiversity.

The lack of rainfall has also had a negative impact on water management, with groundwater increasingly being in irrigation and modern agriculture, seaside tourism and urban populations. The adoption of aquifer contracts by establishments in this sector, with the support of regional politicians, seeks to reduce the indirect effects of drought periods, encourage more responsible use of irrigation water and plan and fund a water reuse system for the large city of Agadir.

1.60. Changes and trends in the biosphere reserve: from a regional project to a region of projects.

The most significant change in terms of short- or medium-term impact for the Arganeraie Biosphere Reserve has been the adoption of a new constitution in 2011. It provides an official place for civil society and participating stakeholders as well as the power to make proposals regarding political policy and regional governance in defence of social parity and solidarity. It plays an important role in environmental management by committing to the preservation of world heritage and alignment with international standards.

The advanced regionalisation project also contributes towards the decentralisation of management and decision-making powers at the regional level.

Another important development for the biosphere reserve was the creation of the National Agency for the Development of Oasis and Argan Areas (ANDZOA) in 2010. Its objectives complement those of the South-west Regional Office for Water and Forests (DREF-SO) by applying the three objectives of the Arganeraie Biosphere Reserve: conservation, development and logistic support. In the reserve, the agency focuses on socio-economic development in the most disadvantaged areas, improved

connectivity and development of the argan oil sector by encouraging scientific research and supporting efforts to preserve and rehabilitate argan ecosystems.

In 2014, practices and know-how regarding the argan tree were named "Intangible Cultural Heritage of Humanity" by UNESCO, and this consolidated the area's recognition as a biosphere reserve.

In 2018, the Society for Regional Tourism Development (SDRT) was created. Its main aim was to revitalise the inland areas of the biosphere reserve through structuring projects to drive the sustainable development of profitable tourism for the region.

During this decade, the economic situation in the biosphere evolved significantly owing to the development of the argan oil industry, boosted by state support and access to international markets, and increased sales of regional products, particularly aromatic plants and honey. However, this change was also accompanied by regional changes as the active population increasingly left rural areas and the mountains to seek better employment opportunities in the lowland and coastal towns.

Climatic changes were also notable during this period, with a marked reduction in snowfall on the highest peaks of the biosphere reserve leading to a net reduction in water flow to feed the region's dams. In turn, this negatively impacted the crops irrigated with water from these structures.

Fires have also been a serious problem in the forest massifs, 80% of which are argan trees. These fires are fierce and likely the result of social factors, particularly the rural exodus and the transformation of production processes. A significant increase in the number of wild boar has also been observed in natural areas, moving between forests and crop fields. This period also saw the highly remarkable return of Cuvier's gazelle in the Anti-Atlas.

Lastly, the flow of livestock herds towards the region has intensified, with these regions of the biosphere reserve becoming more attractive depending on the seasonal rains that year. This generates tension and conflict around the local use of resources. In the past, argan plantation owners regularly received neighbouring farmers and shared available resources. Today, with population growth, climate imbalances, social change and the transformation of production processes, these practices have become less common and the competition for resources has increased.

Between the two periodic reviews, the total population of the provinces covered by the biosphere reserve has grown from 2.78 million to 3.12 million, with an average growth rate of 11%. It is important to stress that the socioeconomic indicators in the townships are much different to those observed at a regional or national level. The development of these areas, therefore, remains an important objective to be addressed.

Following the creation of ANDZOA, another important event during this decade was the founding of the Interprofessional Association of the Argan Sector. This association brings together stakeholders from across the industry, from producers to

exporters. The federation of argan rightsholders enjoy a privileged position within this organisation and promotes the development of partnerships, contacts and exchanges between stakeholders.

The Department for Water and Forests, which is represented by regional delegations, is the core stakeholder in implementing conversation projects focused on ecosystems, biodiversity and sustainable development. Many consistent programmes were initiated during this decade, particularly those related to the regeneration of argan ecosystems, the fight against erosion and monitoring and preservation of biodiversity in the biosphere reserve's natural habitats.

As a management body for the Arganeraie Biosphere Reserve, the Regional Office for Water and Forests and the Fight Against Desertification (DREFLCD) oversees the coordination and integration of projects at the planning level and engages in negotiations for certain interventions. The key element for ensuring the integration of projects is the group of participating stakeholders. Local and socio-professional associations are very present, and their role is important if not highly influential.

Supported by these participating stakeholders, the management body oversees regional development and management and seeks to promote the biosphere reserve concept. A federation is structured around the biosphere reserve as a regional project.

1.61. The complexity and improvement of the biosphere reserve's governance

An analysis by the Arganeraie Biosphere Reserve reveals the following:

- Climatic hazards and disruptions have become a key factor for effective conservation activities;

– Regional contrasts mean that a review is required in terms of intervention and planning. Achieving a balance between conservation and development will depend upon the scale of intervention and the number of interests concerning development. Regional alignment becomes a key part of balancing these two functions. At the regional level of closer community management, the village is the essential foundation for local development (water, electricity, education, etc). Regional administration is handled by the township, where governance is the responsibility of a council of elected officials and an administrative structure that follows a defined action plan, subject to support at the provincial level. The Arganeraie Biosphere Reserve covers eight provinces with more than 160 townships:

- Where national and international trends exert greater influence, demands for development is greater than the demand for conservation;

- The assessment of conservation and development efforts is often performed in a linear or quantitative manner. However, the biosphere reserve concept was designed to seek a balance between conservation and development. There are not currently the
scientific tools or any practical approach for measuring the balance between these two competing functions;

- The Arganeraie Biosphere Reserve federation of stakeholders currently shares a collective interest in terms of the contributions and benefits of this way of managing the region. Similarly, this sharing includes the right and obligation to take their time over the definition of any concept, label or regional project.

The biosphere reserve takes a complex picture of multiple interest groups and huge local variability, which greatly impact the effectiveness of regional governance, and makes it the focus of sustainable regional development.

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Chapter 14

Close-up on the Intercontinental Biosphere Reserve of the Mediterranean (IBRM)

Key Details			
Country	Spain and Morocco		
Name of Biosphere Reserve	Intercontinental Biosphere Reserve of the Mediterranean (IBRM)		
Date of designation by UNESCO	2006		
Management Structures	IBRM Mixed Coordination Committee (Department of Water and Forests of the Kingdom of Morocco. Ministry for the Ecological Transition of Spain and the Regional Government of Andalusia.)		
Land Area	Area: 907,185 ha 81,436 ha of core areas Morocco: 65,342 ha Spain: 16,094 ha Marine area between the two countries: 13,050 ha		
Population	Morocco: 402,227 Spain: 126,589 Total: 529,086		
Protected Areas	Morocco: 1 national park, 1 future natural park, 5 SBEI. Spain: 4 natural parks, 4 natural areas, 5 natural monuments, 13 SACs, 10 SPA declarations.		

According to www.unesco.org/mab and Mchir Derak.

 Table 25.1. Key details of Intercontinental Biosphere Reserve of the Mediterranean.
 The Intercontinental Biosphere Reserve of the Mediterranean is the first intercontinental reserve declared by UNESCO. This reserve includes a marine corridor and draws a scenario of communication and collaboration between two continents with different conditions: Europe and Africa.

It runs between southern Andalusia and northern Morocco, forming an open arc towards the Mediterranean and fractured by the Strait of Gibraltar. The uniqueness of this natural and socio-cultural crossroads - where the Atlantic influence is a determining factor - is exemplified by its main axes: mountains, water, Spanish firsts and Andalusian culture, as well as the environmental and socioeconomic complementarity between its northern and southern sections.



Figure 25.1. Zonation of the Intercontinental Biosphere Reserve of the Mediterranean. Moroccan Department for Water and Forests (2017).

The natural support of the biosphere reserve are the mountains of the large and rugged Bético-Rifeña mountain range, which extends through Andalusia and northern Morocco, with heights ranging from over 500 metres in the Strait of Gibraltar to 2,170 metres in the Jbel Lakraay, creating natural conditions shared by both shores. These mountains, with their abrupt reliefs, have a large amount of water, which has generated various environments that are home to more than 2,000 species of flora and fauna, with important endemic species, such as the Spanish fir, the black juniper or the Atlas cedar. In addition, the Strait of Gibraltar plays a key role in the migration of European and African birds, with a rate of 1,000 birds per hour, as well as the movement of different species of cetaceans and the development of biotic structures like coral.



Figure 25.2. Landscape of Tallasemtane National Park. Credit: M. Derak.

The biosphere reserve is an attractive area for visitors, due to its beautiful landscape combined with a socio-economic system typical of mountain areas near the sea. These areas combine the traditional use of natural resources in agriculture, livestock, fishing and forestry with the communication and marketing possibilities offered by their ports. With the promotion of tourism, the administrations on both sides of the Strait hope that those who visit these areas will observe the similarities of the natural, historical and social values that are shared within the intercontinental biosphere reserve framework.

Marking the border area between Europe and Africa, the regions of Andalusia and Rif share significant historic, political, economic and intercultural roots as well as orographic and environmental similarities and biogeographic continuity.

The most remarkable characteristic of this biosphere reserve is the willingness to promote a sustainable development model within a framework of institutional collaboration. This collaboration in turn has given birth to the IBRM action plan that focuses on promoting sustainable development, improving environmental conditions and enhancing the reserve and its governance.

Therefore, in order to conserve and enhance the region's natural and cultural resources, the IBRM carries out various projects focused on:

 Promoting instruments that allow discontinuities between natural systems to be overcome and improve collaboration between local companies;

- The development and enhancement of shared historic, cultural and natural traits;

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- The comprehensive development of both shores of the IBRM (in terms of agriculture, rural development, the environment, culture and tourism);



Figure 25.3. Landscape of Bouhachem. Credit: M. Derak.

- The promotion of scientific and technical exchange and training for managers of protected areas.

The biggest challenge for the IBRM is how to find a compromise between preserving traditional activities on both shores of the Mediterranean whilst developing new activities such as tourism and modernisation with respect to agriculture, livestock farming and industrial production.



Figure 25.4. A street in Chefchaouen. Credit: M. Derak.

Chapter 15

Impact of Forest Fires on Sustainable Development in the Intercontinental Biosphere Reserve of the Mediterranean

Rachid Sammoudi, Abdelkader Chahlaoui, Nadia Machouri, Lahoucine Amzil, El Habib El Azzouzi, Reda Nacer, Kawtar Jaber, Maya Kouzaiha

1.63. Introduction

Conservation and the sustainable use of natural resources are major challenges but are key for guaranteeing human livelihoods. Forest ecosystems are rich in vital resources, such as food, materials, medicines and fuels. Thanks to their ability to regenerate naturally (without human intervention) or artificially (with human intervention), the forest offers a wealth of natural biodegradable products to meet human needs for energy, equipment and infrastructure.

Forests are today subject to significant pressure and are a key part of the water cycle and soil conservation, being home to great biodiversity and having the ability to absorb important amounts of carbon emissions.

Various summits, meetings, treaties, conventions and projects have tried to move people towards more sustainable forms of development, and the results are 17 sustainable development goals consisting of 169 targets to be achieved by 2030.

One particular characteristic of the Mediterranean region is the risk to forest ecosystems of fires. Forest fires constitute a serious threat to the survival of the ecosystem, depending on the social context of the area and the extent to which the community makes use of wooded areas. Impact of Forest Fires on Sustainable Development in the Intercontinental Biosphere Reserve of the Mediterranean 153



Figure 27.1. Site of Biological Interest of the Moroccan part of the IBRM. (Copyright M. Derak).

Forest fires in the Moroccan part of the Intercontinental Biosphere Reserve of the Mediterranean are largely started to create new areas for crops. Here, large areas are dedicated to illegal cannabis crops on private land and forest areas which have been cleared and burnt, regardless of state ownership or conflict with responsible departments. The region is therefore a place of tension linked to the spread of cannabis crops as growers attempt to evade the authorities and sell the product of their harvest. As a result, the slashing and burning of thousands of hectares of forest each year is degrading natural areas and their ecological role, particularly in the provinces of Chefchaouen, Larache and Tétouan.

These fires could be detrimental to the natural heritage of the Rif, especially its forest ecosystems in the province of Chefchaouen and surrounding area, where the growing of cannabis represents a major challenge for the Moroccan government in achieving its SDGs.

How can a balanced ecosystem be established and conserved? How can forest ecosystems, in particular, be protected and guaranteed? How can local development be promoted? How can village populations be engaged so that they move towards renewable resources and use resources responsibly whilst diversifying their revenue streams?

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1.64. Forest fires in the Northern provinces

The perception of forest fires changes between eco-regions and between countries depending on the context, how fires are started, how widespread they are, the views of stakeholders (ecological scientists, managers, politicians, etc.) and the strategic approach adopted for the forest area in question.

Whilst natural fire is an important part of the forest life cycle, the growing number of them is considered to be a disaster for the forest ecosystems concerned, nearby settlements and infrastructure and a threat to human life and health because of toxic fumes. Natural fires ravage the forests each summer, triggered by lightning, drought or intense heat, without mentioning those fires started by criminals or by accident.

In the absence of pastoral farming activity on the north coast of the Mediterranean, many thousands of hectares went up in smoke during the last few decades in France, Portugal, Spain and in Greece. By comparison, there are relatively fewer and smaller forest fires on the southern coast. However, they constitute a serious threat to biodiversity in the Rif in the north of Morocco, where they are larger and more numerous than in the rest of the country. The susceptibility to fires is at its highest from June to October, with a Fire Weather Index (FWI) varying from 30 to 55 (Jesus *et al.* 2019), mainly brought about by a dry period resulting in increased flammability of the biomass. This is further compounded by the rugged terrain and inaccessibility which impedes any intervention.

In this region, more than 80% of fires happen in August and September and the majority are criminal acts. The average number of fire outbreaks and their average surface area over the last decade has risen to 39 fires and 497 ha/year, with a maximum of 1,371 ha recorded in 2019 (Figures 1 and 2). Investigations into the causes of fires, carried out by the local forest authorities, have concluded that almost all (99%) fires are started by man, whether through carelessness or deliberately to clear forest areas for farming land (DPEFLCD-CH, 2019).

The extent of fires increases during years where humid winters and springs have produced significant biomass (grassy and shrub layers). This becomes an abundance of fuel during the dry season and burning of the tree layer is more likely. The severity of fires depends on the density of the undergrowth, the presence of highly flammable species and the humid, sub-humid and semi-arid bioclimates that dominate around 60% of the region (Mharzi Alaoui *et al.* 2015). Once again, this is further exacerbated by rough terrain and inaccessibility.



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Figure 27.2. Evolution of the number and surface area of forest fires in the province of Chefchaouen 2009-2019 (Source: DPELCD of Chefchaouen).



Figure 27.3. Location of forest fires in 2019 in the province of Chefchaouen.

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1.65. Link between sustainable development and forest fires

The province of Chefchaouen consists of around 50% forest and non-cultivated land, 5% urbanised land and 45% raised agricultural land, which is of little use for modern agriculture that might ensure sustained revenue for the local population.

The population here is 90% rural, with a density of 129 inhabitants/km2, greater than the rest of Morocco (HCP 2014). Village economies largely revolve around food crops (cereals and fruit, particularly figs and olives), on private patches of sloping land next to forest land, or livestock breeding of family herds, mainly goats.

The lack of Useful Agricultural Area (UAA) for crop production increases the anthropic pressure on the forest. During the last two decades, cannabis growing has become the main activity for 90% of village populations, including those that do not own land (ONUDC, 2005). This represents more than 60% of agricultural production in the province of Chefchaouen and appears to occupy more than 40% of the UAA, which is not mentioned in the official statistics (Lakhouaja *et al.* 2017).

The degradation of the soil through the monoculture of cannabis is exacerbated by the deterioration of vegetation coverage, leading to greater water erosion, deterioration of the shoreline and the development of badlands. Burning is also a classic means of fertilisation for cannabis crops.

Despite a provincial herd in the order of 280,000 AU, where 50% are goats (HCP, 2017), the free-range route remains non-aggressive with respect to forest resources compared with other areas with the same biogeographic conditions, particularly the Middle Atlas, where the herbaceous layer becomes rare or absent in summertime.

The rough terrain limits herd movement in the forest massifs and the size of family herds barely exceeds ten AU. This does not allow for most households to have their herd watched over by a family member. The women of the household acquire their forage from the forest areas by gathering the young shoots from the tree layer (essentially hardwood), and firewood (undergrowth and shrubs), to meet their household firewood needs.

There are almost no prohibitions on cutting live wood for commercial purposes and the legal harvesting of deadwood by the local population, as a usage right, does not seem significant in relation to the risk of forest fires.

Faced with the fragility of these ecosystems, an increasing ecological imbalance, a similarly unequal socio-economic context and growing pressure from international bodies, the Moroccan state has undertaken a number of actions in an attempt to balance local development, conservation, the security of forest ecosystems, biodiversity, the state ownership of forests and the demands of international institutions. The Moroccan government has initiated numerous integral development projects since the 1960s. These include DERRO with the world bank, GEFRIF in the 90s, MEDA Chefchaouen, DRI-GRN in the 2000s in collaboration with the European Union, INDH phase I and II from 2005, Green Morocco and various multi-sector projects (promotion of ecotourism and handcrafts, connectivity improvement programmes, combatting the cold snap, etc.). It has also created an agency dedicated the development in the northern provinces (ADPN) to drive development and regional promotion and improve the organisation of economic and social projects. These measures and investments are designed to boost the local economy, limit the spread of cannabis farming, enhance natural resources, the landscape and climate potential, protect forest ecosystems, slow the rural exodus and ensure social peace.

1.66. Conclusion

An analysis of the causes of forest fires reveals that biophysical factors (flammability of species, climate, topography, exposure, inaccessibility, etc.) are not the sole causes of the degradation of forest resources and biodiversity. Socioeconomic factors constitute the main trigger for forest fires in the Moroccan part of the IBRM as people seek to take over useful space for cannabis farming. The existence of a large population in a rural setting leads to a dependence of the waterside population for subsistence, on forest resources and nearby state-owned land and, apart from cropland (small parcels on slopes), on other income-generating activities, except the growing of cannabis, which is now illegal.

The legalisation of cannabis farming (which has been illegal since the 60s), the withdrawal from cannabis resin from the list of narcotics and the inclusion of revenue in the country's GDP would be a significant economic opportunity. If this were to occur, hypothetically, it would become vital to implement measures to secure the forest land and resources, establish sustainable management in collaboration with local populations, protect the forest landscape, promote social protection and reduce regional inequality. It would also become important to review the provincial urban planning policy by creating satellite towns and urban centres designed to modernise life for villagers and eradicate their dependence on unrestricted access to natural resources.

The protection, securing and enhancement of natural ecosystems would not be possible were it not for the effective involvement of the user population and local collectives under the leadership of the responsible department in its new strategy entitled "Forests of Morocco 2020-2030".

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Chapter 16

The media coverage of the biosphere reserve: ambivalence between the protection of nature and the promotion of territories. The Case of RBIM

LaoucineAmzil, Yamina El Kirat El Allame et Faiza El Mejjad

1.68. Introduction

Morocco has adopted a number of strategies related to environmental communication with the aim to increase people's awareness. Moroccan TV programs illustrate the implementation of media in the protection of the environment. This proves the State's willingness to improve knowledge about the different values of the Biosphere reserves.

The aim of the present study is to investigate the Moroccan environment policies and the power of communication in the promotion of the biosphere reserve notion. Its main objective is to reveal the roles and functions of media in educational awareness. The study will also try to uncover the roles of stakeholders and their contribution to public awareness. The study adopts a mixed approach so as to collect people's attitudes and perceptions on the issue. The data is analyzed through the Statistical Package for the Social Sciences (SPSS) and R INTERFACE for multidimensional analysis of texts and questionnaires) (IRAMUTEQ).

Given the urgency and the need to maintain the quality of the biosphere and the environment in Morocco, it has become mandatory to develop environmental education and awareness and increase the participation of people in environmental issues in the Biosphere reserves. The implementation of territorial communication can mobilize the populations of the different areas so as to maintain their attractiveness.

1.69. Biosphere Reserves: General Background

The quality of the environment and biodiversity conservation depend on public awareness. The latter is essential for sustainable human development. The protection of the habitat should be part of all the countries' strategies. Countries have been trying to take decisions and make new choices in environmental governance so as to keep the balance between man and the environment. People's awareness of the value of the environment may reduce environmental deterioration. Hence, the need to exploit media as an efficient means to raise people's awareness of the environmental problems and issues and urge them to take action to protect the environment. Biosphere reserves can play an important role in the sustainable development goals and contribute to improving the economic, environmental and social conditions of the local communities. Biosphere reserves offer good ways to protect ecosystems, and encourage the local economies to build up rural areas. Indeed, as UNESCO puts it, Biosphere reserves *are "learning places for sustainable development"*. They also "provide local solutions to global challenges¹" as they play an important role in the conservation of the ecosystems, landscapes, species.

The aim of this section is to give a brief overview about people's degree of awareness about Biosphere reserves and their familiarity with the concepts related to them and their meanings and definitions. In order to find out about people's understanding of what a Biosphere is, the study investigates a group of participants from different educational levels and from different cities.

The present study adopts a mixed-method approach making use of both quantitative and qualitative research instruments. This helps to recognize the influence of social media practices on the development of environmental awareness in Biosphere reserves. The use of qualitative data is used basically to analyse the discourse of stakeholders through the language they use and their behaviour towards the RBIM. Quantitative data is also used to measure the behavior of the respondents in RBIM and their opinion about the media in relation to the delivery of information about their environment.

Due to COVID-19, the snowball technique was used with the intention and effect to get the help of the respondents in the recruitment of other respondents. The snowball technique was the most effective way to reach respondents due to the constraints that interrupted the field work process, namely the lockdown/confinement, quarantine, lack of transportation, etc.

Two questionnaires were designed for the research. The data is collected from the public includes 45 respondents. The aim of this questionnaire is to find out if people have a prior knowledge on the concept of biosphere reserve. The second questionnaire is administered to 30 residents in Chefchaouen, Tetouan, and Tangier. The purpose of this questionnaire is to determine whether the residents of a biosphere reserve are

¹ UNESCO (2019), Biosphere reserve, available from https://en.unesco.org/biosphere/about [Accessed: July 2012].

aware of the fact that they live in a biosphere reserve. The questionnaire also seeks to investigate whether the RBIM in Northern Morocco is making use of any media and resources.

A field study is conducted in the RBIM to observe different aspects, namely: Agriculture, the status of women, social economy and the role of media in relation to each aspect.

The stakeholders and participants were contacted by email for both the interview and the questionnaires during the period between August 2020 and October 2020 in a first round and later on by telephone to conclude their collaboration by a visit to the field during the months of October and November for a period of 15 days.

What do you know about biosphere reserves in Morocco?				
	Numbers	%	Cumulative percentage	
A large wooded area	2	4.4	4.4	
Areas where there is no human activity	2	4.4	8.9	
Forests in which there are species of animals and plants	8	17.8	26.7	
Green area	1	2.2	28.9	
Large lands with animals that should not be hunted	1	2.2	31.1	
No idea	14	31.1	62.2	
Prohibit hunting for the protection of species	1	2.2	64.4	
Protected area in which there are species of animals and plants	2	4.4	68.9	
Protected areas located in forests	1	2.2	71.1	
Protected places to preserve the environment and species	9	20.0	91.1	
Subject to special and strict law	4	8.9	100.0	
Total	45	100.0		

 Table 29.1. Definition of biosphere reserve by RBIM's respondents. Source: Field

 survey EL MEJJAD F., 2020.

	Numbers	%
Agadir, Souss Massa	1	3.3
Ain Errami	1	3.3
Akchour	2	6.7
Akchour, OumRabii	1	3.3
Chefchaouen	1	3.3
I don't know	10	33.3
MoulayBouselham	1	3.3
Oasis Zagoura	1	3.3
RBIM	4	13.3
RBIM, RBA	3	10.0
Talassemtane	2	6.7
Talassemtane, Bouhachem	1	3.3
Talassemtane,Akchour, sidiAbdelhamid	1	3.3
Tidghin	1	3.3
Total	30	100.0

 Table 29.2. Respondent's Awareness of Moroccan biosphere reserves. Source:

 Field survey El Mejjad F., 2020

The data analysis reveal that the respondents do not differentiate between Biosphere reserve, natural park or natural reserves. As table (1) below shows, many of the respondents are not aware of what a biosphere reserve is as 31.1% declare that they have no idea what a biosphere is and do only provide definitions which are close to the concrete meaning of the biosphere reserves. Indeed, only 20% of the respondents opt for the statement "Protected places to preserve the environment and species".

The respondents' awareness and familiarity with the Moroccan biosphere reserves seems to be very low as 33.3% of the respondents claim not to know much about the issue. Only 13.3% of the respondents seem of be familiar with the RBIM, and 10.0% claim to know the RBIM, RBA. These figures reveal the lack of information about the BRs in Morocco and the urgent need to adopt communication strategies to develop people's awareness of them.

The survey also reveals that most of the respondents cannot differenciate and distinguish between a BR and a natural reserve as 43.3%, claim that they don't know what biosphere reserves are. Indeed, most of the definitions they provide are based on their personal perceptions and knowledge about the issue. They are close to the concrete meaning of the concept as they only relate it to nature based on the terms 'Biosphere' and 'reserve.

	Numbers	%	Cumulative percentage
A place that preserves biodiversity	1	3.3	3.3
A protected area that combines two continents	1	3.3	6.7
A protected area that combines two continents with plant and animal diversity	2	6.7	13.3
A UNESCO territory that respects biodiversity	1	3.3	16.7
Conservation of biodiversity	1	3.3	20.0
Forests and fauna	1	3.3	23.3
I didn't hear about it before	2	6.7	30.0
I don't know	13	43.3	73.3
I know reserves like Bouhachem and Talassemtane	1	3.3	76.7
Living organisms that live in a natural environment	1	3.3	80.0
The atmosphere, soil, animals	1	3.3	83.3
The first time I hear about the concept	1	3.3	86.7
The living beings	1	3.3	90.0
The protection of nature	1	3.3	93.3
They contribute in sustainable development.	1	3.3	96.7
They mean forests reserves.	1	3.3	100.0
Total	30	100	

 Table 29.3. Diferenciation between BRs& Natural Reserve by RBIM's respondents. Source: Field survey El Mejjad F., 2020.

The results of the key questions addressed in the survey relates to the means of information respondents rely on to find out about the existence of Biosphere Reserves in Morocco presented in table (4) below reveal that a total of 35.6% of the respondents do not seem to be aware of the existence of Biosphere Reserves in Morocco. Those who report to be aware of them, a total of 20%, state to have heard about them via the internet and TV, while only 15% claim to have been informed by friends. This reveals

the importance of the media in the urgent need for the promotion of educational awareness through the exploitation of media for development of communication strategies for the visibility of BRs in Morocco.

	Number	Percentage	Cumulative percentage
Accidentally	1	2.2	2.2
Advertisement signage	1	2.2	4.4
Books	1	2.2	6.7
Conference	1	2.2	8.9
Family	4	8.9	17.8
Friends	7	15.6	33.3
I don' t know	16	35.6	68.9
I don't remember	2	4.4	73.3
Internet and studies	1	2.2	75.6
Internet and television	9	20.0	95.6
Work	2	4.4	100.0
Total	45	100.0	

 Table 29.4. Means of information about the existence biosphere reserve in Morocco. Source: Field survey EL MEJJAD F., 2020.

It should be noted here that media, in general and some Moroccan media in particular, have, indeed, shown interest in the environment and the environmental issues recently as societies are becoming more and more aware of the harmful anthropic actions on the environment. This can explain the respondents' awareness of BRs through media in the survey. Thus, Media have been playing a key role in developing people's awareness of the environmental issues and spreading consciousness of the need to protect it. This is, however, still very limited and needs more efforts, a clear vision and efficient measures and strategies.

1.70. The media environment around the biosphere reserve

Certain tools such as academic sources, touristic maps, social media and word to mouth information seem to have an impact on environmental awareness of the respondents of RBIM (Figure2). In analysing the environmental consciousness of the respondents, it is of relevance to look closely at the sources which play a key role in informing the respondents and being the source their awareness of the environment in general and RBIM in particular. The figure below shows that 56,7% of the respondents seem to prefer social networks; while only 16,7 % of the respondents claim to favor Academic sources, 13,3% rely on press as the main means of



information and 3,3% of the respondents depend on touristic signs to get information about the RBIM.

Figure 29.1. Source of information about the BR/ NR. Source: Field survey El Mejjad F., 2020.

	Percentage %	Cumulative percentage
Distance and price	11.1	11.1
I don't know	4.4	15.6
Lack of advertising	6.7	22.2
Lack of services	4.4	26.7
Lack of signage	6.7	33.3
Lack of transportation	2.2	35.6
Neglect and lack of concern for natural reserves	6.7	42.2
No problems	8.9	51.1
Pollution and fires	2.2	53.3
Pollution and insecurity	6.7	60.0
Poor infrastructure	15.6	75.6
The outbreak of fires	6.7	82.2
The pollution and deterioration of natural species	8.9	91.1
There are no restrictions	8.9	100.0
Total	100.0	

Table 29.5. Problems that interrupt the knowledge of RBIM. Source: Field surveyEl Mejjad F., 2020.

RBIM is a destination that fits in with the international trends in the ecotourism market in Morocco; it is a destination of cultural tourism and authentic experiences close to people and nature. However, some obstacles delay the building of this biosphere reserve image. As the table below indicates, the respondents complain about the poor infrastructure, the lack of suitable signage in the territory, the distance and the price, and the safety to mention only these.

This study also reveals that the respondents do not update themselves about the environmental issues and news in their surroundings, which is noticeable in their answers. Indeed, if a person looks for the environment in Chefchaouen, Tangier, Akchour, Tetouanon the internet, he/she will immediately find the concept of biosphere reserve in the research and educate him/herself about it. Actually, this reveals that Moroccans are still not much interested and concerned about the environment issues and that the culture of cultural or ecotourism is still not widely spread in society. This is partly due to the lack of information about the biosphere reserves in the communication channels as it will appear in the following section.

1.70.1. Place of the biosphere reserve in the media channel

Communication channels are powerful and can have an impact on the parties, institutions and society as well. They can be a means for stakeholders, civil society and citizens to cooperate and have a constructive dialogue to address environmental issues in Biosphere reserves and try to look for solutions to the challenges facing these areas. Indeed, stakeholders and citizens use different communication channels that can motivate the public participation and develop awareness and collaboration among the members of society. Communication channels can contribute a lot to the development of people's awareness of the environmental degradation and can motivate those who are willing to act to limit environmental degradation and improve and enhance environmental conservation take action. Thus, people who watch and listen to local stations i.e., MBC 5, 2M, Al Oula, tend to be more attentive to achieve environmental sustainability. Media is the best mean for creating this kind of influence. The pictures, videos, plays (figure 2), and documentaries are used to pass the message and spread the information in a simplified form so that everyone can understand it clearly. This game highlights the knowledge and the general culture on the biosphere reserves.





The level of knowledge about the concept of biosphere reserve in the present study has The type of information the respondents get from the internet are about fauna, flora, fire, extinct fauna and news related to natural disasters (Figure 4). However, other respondents complain about the scarcity of information on television and radio stations. This reveals the necessity to improve the situation and urge the media to get more committed to the cause.

been identified on the basis of the respondents' attitudes and the way they rate their access to information and news about biosphere reserves. Figure (3) shows the numbers and percentages of satisfaction about access to information.



Figure 29.3. Degree of satisfaction with access to information about NR or BR. Source: Field survey El Mejjad F., 2020.

Though the rates for 'very satisfied' and 'satisfied' seem to be higher than those for 'very unsatisfied' and 'unsatisfied', the rate for the respondents who are neutral and did not take any position is very high and is very close to that of the ''very satisfied'. The option 'neutral' can actually be interpreted in a negative way and as a way to show lack of interest and care about the issue or a way to avoid openly declaring lack of satisfaction.



Figure 29.4. Type of information respondents get about environment. Source: Field survey El Mejjad F., 2020.

Respondents are also asked about the information they miss, and their answers were very close and vary between learning about biodiversity, new lands, discovering new reserves in Morocco. These answers show the ineffectiveness of Moroccan programs in providing information about Moroccan lands and landscapes (see table 5).

	Numbers	Percentage	Cumulative percentage	
I want to know more about our country	2	6.7	6.7	
Learn about Biodiversity	5	16.7	23.3	
Learn about fires in forests	1	3.3	26.7	
Learn about reserves and natural lands	5	16.7	43.3	
Learn about extinct species in our country	5	16.7	60.0	
The importance of biosphere reserves	1	3.3	63.3	
The location of beautiful reserves	1	3.3	66.7	
To discover new touristic lands	1	3.3	70.0	
To learn about extinct fauna	1	3.3	73.3	
To learn about new reserves	7	23.3	96.7	
To learn about new reserves and new cultures	1	3.3	100.0	
Total	30	100.0		

 Table 29.6. Needed information according to respondents. Source: Field survey

 El Mejjad F., 2020.

The above table shows that the respondents are interested in finding out and learning more about new reserves in Morocco; they also want to learn about biodiversity, and natural reserves, and about the extinct species in the country. This is a good indicator for people's interest in the subject matter and the possibility to improve the degree of environment awareness in the society.

1.70.2. Role of media and biosphere reserve actors

The present study tried to address the issue related to the domains of improvement that should be made in order to improve the attractiveness of Biosphere reserves or natural reserves according to the respondents on the basis of statements provided. The highest number of respondents opted for the statement related to educational awareness and surveillance and the need for more advertising on Television, at 40%. Improving the touristic sector and logistical equipment were highlighted by 26.7% and 22.2% of the respondents respectively (see table 6 below). This shows again the weak infrastructure and logistics of the touristic sector and the need to improve it.

	Numbers	%	Cum. Percentage
Cleanliness and safety	4	8.9	8.9
Educational awareness and surveillance, providing more advertising in Television	18	40.0	48.9
Improving touristic sector	12	26.7	75.6
Providing logistical equipment	10	22.2	97.8
Management of nature and Earth's biodiversity with aim of protecting species, their habitats, and ecosystems from excessive rates of extinction and erosion of biotic interactions.	1	2.2	100.0
Total	45	100.0	

 Table 29.7. Required improvements in BR/NR according to respondents.

 Source: Field survey El Mejjad F., 2020.

The promotion of the infrastructure and logistics of the touristic sector will surely promote ecotourism and increase people's environment awareness and preservation of biosphere reserves. A number of promotional measures can be used in order to promote the landscape of RBIM. As table 5 below shows, the majority of the respondents, i.e., 71%, claim that tourism is the main reason for visiting the RBIM. In fact, the promotion of biosphere reserve by touristic institutions via advertisement, Guidebooks, travel agencies can contribute immensely to the mediatization of the RBIM.



Figure 29.5. Reasons of visits of RBIM according to respondents. Source: Field survey El Mejjad F., 2020.

1.71. Representation of RBIM in the Moroccan media

The representation of biosphere reserves in general and RBIM in particular in the Moroccan media play a key role in their visibility. The aim of this section is to discuss the role of stakeholders in the visibility and access to RBIM and the measures and strategies to be adopted for improving awareness of the biosphere reserves in Morocco. Each aspect is addressed below.

1.71.1. Role of stakeholders in the visibility and access to RBIM

The Department of Water and Forests is working on improving the conditions for the raise of the awareness of the public and their environmental education. One of their main missions, besides the preservation of natural resources and biological wealth in protected areas, is environmental awareness and the education for a large public.

D.M: [...] I would say that access remains at average level. There is work and research on RBIM, unfortunately we do not have specific RBIM websites like European biosphere reserves. [...] If you go to the Spanish website, you will find all the information on RBIM. So, the level of communication in Morocco remains average [...]

[HCEFLCD, Tetouan, 07-11-202]

This interviewee's testimony is very revealing and shows that even those who work within the system notice the stark difference between the Spanish and Moroccan RBIM projects.

Through the national network of protected areas, and by implementing "environmental education programs", the Department of Water and Forests works on establishing an environmental culture among the Moroccan public, spreading awareness regarding the concepts of sustainable development and biodiversity as well as increasing public communication and media debates on these themes. However, despite all these efforts, the promotion of Biosphere Reserves in Morocco is still of little impact.

The associations adopt different tools and techniques to promote the RBIM, they also implement many strategies and participate in programs to develop the promotion of the RBIM. However, the ways the use media to approach the public is somewhat outdated.

Another type of media coverage can exist to highlight how associations in Chefchaouen contribute to sustainable human development by improving the living conditions of the population and protecting the environment of the territory of the RBIM.

[...] The promotion in Chefchaouen is very weak. The ancient cooperatives do not find someone who can help them in this sector. Unlike us we try to make this cooperative well-known and we organize for them training courses to ameliorate their competences in the promotion side [...]

[Coordinator, Bouhachem park, 2020-10-26]

The investigation of the issue in North Morocco revealed the presence of a number of institutions in Chefchaouen in charge of the promotion and protection of the biosphere reserves, namely:

- ADL : Association de Développement Local de Chefchaouen (ADL Chefchaouen). The Association for Local Development Morocco "ADL-Al Maghrib", formerly called Association for Local Development in Chefchaouen, "ADL-Chefchaouen" is a non-governmental organization with a socio-economic and cultural character, but with no profit goals. Its main objectives are to support touristic projects in Chefchaouen, protect the environment, educate, govern, and involve the population in the development process (figure 6).

– ATED: Talassemtane Association in Chefchaouen, whose main goals are to spread awareness of environmental issues among citizens, defend the citizen's right to live in a healthy environment, sensitize the citizens, safeguard the environment, carry out programs related to human development in the province, as well as promote ecological tourism. - Association Assaida AL Horracitoyenneté et égalité: Contributes to the promotion of equity and equality between women and men in the Tangier-Tetouan region.



Figure 29.6. Stakeholders' role in biosphere reserves. Source: UNESCO. 2001. Steps and tool towards integrated coastal area management.

Generally, cooperation between the different actors, managers, decisions-makers, experts, institutions and society can play an important role in the prevention and control of environmental degradation. It may also help in spreading awareness about new landscapes. It is a hard task to convince people to come together and to attain a common goal. This requires a lot of efforts and argumentation to bring people together and help all the members of the community to understand the concept of biosphere reserves, its importance and value. It is crucial to mention here that the local populations are not aware of the potential of their territories.

The study reveals that the bad state of the signage of the territory. Besides its being weakly developed and, it's also hardly visible and very heterogeneous. Therefore, tourists have no indications or points of reference or guidance for reaching their destinations. The existing signages are the result of private initiative. Consequently, there are no concrete projects to develop homogeneous tourist signage on the territory. Finally, the maintenance of this signage is often not assured and they are most of the most in very bad states as it is illustrated in figure (7) below.



Figure 29.7. State of the signage in RBIM. Source: Taken by F. El mejjad (2020).

1.71.2. Measures and strategies for improving the biosphere reserves

As the previous section reveals, the state of the biosphere reserves needs a lot of improvement at all levels. In an interview with the president of the Talassemtane association, he declared that they have cooperated with the municipality of Chefchaouen to develop a territorial brand that they have set up under the name "*Gouter Chefchouen*". He stated "We worked on this brand in a participatory way. We worked with agricultural co-operatives and agricultural products. According to our conception, this territorial brand is a way of producing sustainability in the RBIM."

R INTERFACE for multidimensional analysis of texts and questionnaires) has been used in textual content analysis and in the description of the textual discourse of the stakeholders in Chefchaouen. Eleven interviews which were divided into four categories were conducted in Chefchaouen with Tour guide, members of associations, public institutions and officials in parks and natural reserves. A word cloud was generated, which includes the terms with greater frequency and big size are organized graphically. The larger the font and more centred on the cloud, the greater the frequency of the word. This diagram, widely used on the internet, is a lexicometry tool that simply represents the frequencies of forms by correlating them to their size for the words reserve, biosphere, project (see figure 8 below). The word cloud shows that other related words like *natural*, *product*, *medium*, *city*, *awareness*, *development*, *tourism*, *project*, *and information* occur around the terms Biosphere reserve (see figure 8 below).



Figure 29.8. Word cloud generated from the terms biosphere reserve. Source: Field survey El Mejjad F., 2020.

Correspondence analysis (CA), a multivariate graphical technique mainly is used to explore relationships among categorical variables, and is interpreted mainly by comparing the interviewees' statements. The analysis reveals that the park officials and communities hold the same discourse; while the other participants, namely the associations, the engineers of the Water & Forests Department have a different perspective. The tour guides, for instance, tend to talk about tourism and its benefits to the region and its promotion of Biosphere Reserve via tourism (See figure 9).



Figure 29.9. Correspondence analysis & Stakeholders positions Source: Field survey El Mejjad F., 2020.

The chart above offers a representation of the different stakeholders' positions. It shows the link between the different actors who hold the same discourse and those who have different stands.

The people who contribute to the development of the RBIM are a group of actors who work for the municipality of Chefchaouen, state delegations of agriculture, crafts and tourism, etc. Furthermore, this group of actors are economic actors: producers, cooperatives, restaurateurs, owners, craftsmen, etc.

1.72. Concluding Remarks

The aim of this study was to investigate the role of Moroccan policies in the development of communication about the Biosphere reserve notion. Its main goal was to determine how media can contribute to the increase of educational awareness. The study also looked at the roles of stakeholders and their contribution to public awareness. Given the constraints imposed by the pandemic, the study undertook a

pilot study to get a first impression about the issue. Limited as it was, this first investigation allowed to generate a Word cloud from the terms Biosphere reserve, which reveals to be quite interesting.

The main study, which concerned the role of media coverage and communication around the Biosphere in general and Media coverage of biosphere reserve as a means to achieve the SDGs, did not only reveal that most of the participants are not familiar with the term biosphere reserves but also showed that majority of them do not distinguish between Biosphere reserve, natural park or natural reserves. They provide only basic definitions they understand from the term itself.

This study also unveiled that people are not aware of the social and economic changes in their surroundings, and that the respondents' answers vary according to their economic and social background.

The study disclosed the power of communication channels and their impact on both institutions and society at large. In fact, it confirmed that communication can help stakeholders and citizens to cooperate and start a constructive dialogue on environmental issues in Biosphere reserves and find solutions to all the challenges and issues faced. Though Stakeholders and citizens use different communication channels, they can both contribute to the implementation of public participation, awareness and collaboration among the public.

The study reported the respondents' complaints about the scarcity of information on the television and radio stations. Indeed, their answers showed the ineffectiveness of Moroccan programs in providing information about Moroccan lands and landscapes.

Among the main measures that could improve the attractiveness of Biosphere reserves or natural reserves, the respondents highlighted the need to increase the safety measures, the provision of logistics and equipment, and most importantly the raising of awareness via television.

The study also revealed the local populations' lack of awareness of the potential of their territory. This highlights the importance of developing the required tools for interpreting heritage resources which would make it possible to educate the population about the resources of their region.

The visibility and homogeneity of the signage of the territory is crucial. Hence, the urgent need for concrete projects to develop and improve tourist signage on the territory and to guarantee their protection and maintenance in order to promote the ecotourism potentials and resources presented by the RBIM, which has become a destination that is at the level of international trends in the tourism market in Morocco.

Despite all its limitations, this modest study uncovers the strengths and weaknesses of the biosphere sector and calls for a more exhaustive study that can expand to other areas in Morocco and even to comparative studies with the situation in other countries such as Lebanon, which has a lot in common with the Moroccan context, especially at the cultural level.

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