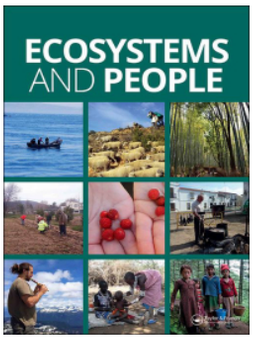

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Exploring implementation differences of UNESCO policy among 38 biosphere reserves across 14 Mediterranean countries

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ABSTRACT

The UNESCO Man and the Biosphere (MAB) programme was created in 1971 with the ambition to combine rational use of natural resources with nature conservation. While concepts, approaches, strategies and terms have evolved, the central goal remains the same today: integrating biodiversity conservation with economic and human development that is socio-culturally and ecologically sustainable. The MAB programme is implemented through the World Network of Biosphere Reserves. Biosphere reserves are defined as learning places and regional units of sustainable development. They are designated by UNESCO but remain under the sovereign jurisdiction of the states where they are located. A key challenge for the UNESCO MAB programme is the local implementation of concepts developed at the international level. We examine how the evolution in policy at the international level is implemented locally. We present results from a survey of 38 biosphere reserves in 14 countries around the Mediterranean Sea. The MAB programme reached a pivotal point with its 1995 Seville Strategy, orienting toward intersectoral policy and local participation. However, 30 years later, our data show differences between biosphere reserves designated before and after this policy shift. Second generation biosphere reserves report governance structures based on municipalities and associations rather than central government authorities or national park administrations and a stronger focus on community engagement. While newly designated biosphere reserves have largely endorsed the MAB programme's evolving policy changes, previously designated sites have had limited success in implementing policy changes.

KEY POLICY HIGHLIGHTS

- Organizational structures and governance systems are key determinants of the biosphere reserves' behaviour. Prior to the introduction of the Seville Strategy, the practice of the MAB program often consisted of additionally designating existing protected areas as biosphere reserves. However, these existing organisations have their own logics, objectives and tasks. In the event of policy changes on the UNESCO level, the management body might often primarily continue with the tasks (legally) defined by the state and consider how it can justify its compliance with new MAB criteria (which are not legally binding)—and hence less relevant.
- Many younger biosphere reserves are facing serious problems with implications for the UNESCO MAB Programme as a whole. The governance systems of the second generation of biosphere reserves are more local and often based on municipalities and sometimes associations. These biosphere reserves apparently have closer involvement with local communities as required by MAB policy. However, some obviously operate under precarious conditions and have less than five, sometimes only one, staff positions. With such marginal resources, it is impossible to even begin to meet the high ambitions of the MAB Programme. The MAB programme needs to focus on creating mechanisms for developing policy integration under circumstances of fragmented governance systems.
- Quality management, like the mandatory periodic review process for UNESCO Biosphere Reserves, is effective and should be expanded: the review process should be able to identify and address lack of community engagement in many first-generation biosphere reserves, but it should also identify and address lack of resources in many second-generation biosphere reserves. Most effective in this regard is the extension process, which is not a quality management measure but seems to have exactly this effect, acting as a policy update for participating biosphere reserves.

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1. Introduction

Like all policies, intergovernmental policy is subject to change and reorientation (Gupta 2010). Reorientation of intergovernmental policy may happen for a variety of often-interrelated reasons, including changes in knowledge (Smith and Stern 2011), changes in social perspectives on the respective issues (Gupta 2010; Weber 2010), influences of non-governmental lobby groups (Peterson 1992) or changes in membership of the intergovernmental organizations and political power relations (Lugg 2024). Additionally, changes in intergovernmental *environmental* policy might reflect the development of environmental threats and scientific knowledge about them (Baldwin and Lenton 2020) as well as changing ideas about governance and management (Jordan et al. 2005).

Using the UNESCO Man and the Biosphere (MAB) Programme (herein referred to as 'the Programme') as an example, we examine how policy developments at the international level influence implementation and adaptation at the local level. The UNESCO MAB Programme is an intergovernmental programme that strives to combine biodiversity conservation with sustainable socio-economic development. The programme is implemented through UNESCO Biosphere Reserves that are designated by UNESCO but are funded and managed under their respective national legislations (UNESCO 2020). Together, all biosphere reserves form the World Network of Biosphere Reserves (WNBR), consisting of 784 sites in 142 countries as of 2025. Each individual biosphere reserve, according to UNESCO policy, aims to be a learning site for sustainable development, combining conservation of biodiversity with sustainable social and economic development (UNESCO 2025). Within the WNBR, biosphere reserves cooperate in thematic and regional clusters, one of them being the thematic Network of Mediterranean Biosphere Reserves (MedMAB).

The concept of biosphere reserves is repeatedly recognised as having great potential for catalyzing sustainable development and biodiversity conservation (Batisse 1997; Bridgewater 2002; Ishwaran et al. 2008). There are, however, implementation differences across the network that might affect the Programme's outcome (Elbakidze et al. 2013; Coetzer et al. 2014; Aschenbrand and Michler 2021). Also, biosphere reserves have not yet been convincingly integrated into the policy of international biodiversity agreements (Barraclough et al. 2021) because they do not fulfil the criteria for protected areas across their entire area and are, thus, difficult to recognize in contributing to quantified globally protected area targets.

With its decentralized structure of biosphere reserves spread all over the globe, the UNESCO MAB Programme faces the difficulty of transmitting policy changes to the local context where implementation of the Programme takes place (Ishwaran 2012). Similar challenges arise in the protected area policy within the Convention on Biological Diversity as different national contexts have developed different forms of protected areas (Dudley and Stolton 2020). Even in the case of the European Union's Nature Conservation Policy, which as a supranational law has sanctions in the event of non-compliance, the implementation of an effective protected area network remains difficult (Trochet and Schmeller 2013). The UNESCO MAB Programme strives to develop local solutions to global challenges (UNESCO 2025), relying on bottom-up strategies and community involvement (Reed 2019) without imposing sanctions. However, in the event of non-compliance, the designation as a UNESCO Biosphere Reserve can be revoked.

Here, we address the question of how policy changes at the UNESCO level affect the work of individual biosphere reserves, as existing literature suggests that the UNESCO MAB Programme experiences difficulties in transmitting policy changes to the existing biosphere reserves (Matar and Anthony 2017; van Cuong et al. 2017). The UNESCO MAB Programme has evolved several times in the more than 50 years of its existence (Ishwaran et al. 2008). Today, however, the statutory framework, which serves as the constitution of the MAB Programme, requires that all existing biosphere reserves, irrespective of the year of their designation, meet the same criteria and fulfill the same functions (UNESCO 2020). Our research question is therefore as follows: are structural differences between older and younger biosphere reserves still evident today? To answer this question, we are using the Mediterranean Biosphere Reserves as an illustrative example. We pay particular attention to the effects of the Seville Strategy of 1995, which is generally regarded as a pivotal point in the development of the UNESCO MAB programme (van Cuong et al. 2017; Bouamrane et al. 2020; Barraclough et al. 2023) and ask: Thirty years after the Seville Strategy, is it still justified to speak of different generations of biosphere reserves, or have older biosphere reserves now also fully implemented the current policy framework? If we find persisting structural differences in biosphere reserves implementation of UNESCO's MAB policy, the question arises as to how the interaction between the policy at UNESCO level and the local level of the biosphere reserves can be further developed in order to enable biosphere reserves to fulfil their ambitious mandate.

2. Development of the biosphere reserve concept

Being a child of the late 1960s, 'MAB was created in a climate of general awakening to all manner of environmental concern' (Di Castri et al. 1981), grounded on the idea that 'scientists (particularly those studying ecosystems), would be at the forefront of finding solutions to human environment problems' (Reed 2019). Biosphere reserves should serve as local real-life research laboratories in which interdisciplinary research is promoted and new model projects for the compatibility of nature conservation and rational use are developed and tested (Di Castri et al. 1981). However, many early designated biosphere reserves did not differ from other protected areas—having a strong focus on conservation and very little focus on the development, local knowledge and research (Reed 2020). This is because existing national parks were often additionally designated as biosphere reserves. In many of these cases, a management organisation with defined tasks had already been in place and the interdisciplinary and multifunctional concept of biosphere reserves posed a major challenge to existing management authorities (Price 2002).

In the mid-1980s, the growing desire to advance sustainable development (UNESCO 1985) resulted in an action plan—the 'Seville Strategy'—and a Statutory Framework in 1995 (Reed 2019, 2020). This framework, still in effect today, serves as the constitution of the MAB Programme and guides both the designation and periodic review of biosphere reserves. The Seville Strategy and Statutory Framework are considered pivotal for the UNESCO MAB Programme (Bouamrane et al. 2020), placing biosphere reserves as regional units of sustainable development in the global imperatives resulting from the United Nations Conference on Environment and Development in 1992.

The statutory framework for the UNESCO MAB Programme describes the three functions that each biosphere reserve has to fulfil (UNESCO 2020):

- **Conservation**: Contribute to the conservation of landscapes, ecosystems, species and genetic variation
- **Development**: Foster economic and human development which is socioculturally and ecologically sustainable
- **Logistic Support**: Support for demonstration projects, environmental education and training, research and monitoring related to local, regional, national and global issues of conservation and sustainable development.

The Statutory Framework also describes the zoning model with core area, buffer zone and transition area, requests the involvement of local communities in the designation process as well as in management decisions and introduces a quality management aspect in the form of a mandatory periodic review (Price 2002; UNESCO 2020). All biosphere reserves proposed after the Statutory Framework took effect in 1995 must meet their core requirements as part of their nomination process. Subsequent action plans within the UNESCO MAB Programme (Figure 1), such as the Madrid Action Plan (2008) and the Lima Action Plan (2015), and the Hangzhou Strategic Action Plan (2025) have also been interpreted as efforts to align the MAB Programme with broader global priorities (Bouamrane et al. 2020). The Madrid and Lima Action Plans integrated the United Nations Millenium Development and the United Nations Sustainable Development Goals, respectively, while the Hangzhou Strategic Action Plan aligns the MAB Programme with the Kunming Montreal Biodiversity Framework. In 2025, biosphere reserves are described by UNESCO as follows:

> Biosphere reserves are 'learning places for sustainable development'. They are sites for testing interdisciplinary approaches to understanding and managing changes and interactions between social and ecological systems, including conflict prevention and management of biodiversity. They are places that provide local solutions to global challenges. Biosphere reserves include terrestrial, marine and coastal ecosystems. Each site promotes solutions reconciling the conservation of biodiversity with its sustainable use. (UNESCO 2025)

The decentralized implementation of the UNESCO MAB Programme in diverse geographic and cultural contexts creates an interesting challenge: policy updates on the UNESCO level have to reach member states and their biosphere reserves, while the development of local solutions requires enough flexibility for bottom-up approaches to governance and management. Reed (2020) and van Cuong et al. (2017) have pointed out the differences between biosphere reserves before and after the Seville Strategy. However, since the statutory framework has been applied to all areas since 1995, we want to examine to what extent older biosphere reserves have used the past 30 years to implement policy shifts, or whether there are still clear differences between the first and second generation of biosphere reserves.

3. Materials and methods

In this paper, we analyse a survey that was designed by the UNESCO International Center for Mediterranean Biosphere Reserves (UNESCOMED-Center) and titled 'Diagnosis of the Biosphere Reserves members of the UNESCO International Center for Mediterranean Biosphere Reserves'. This survey was conducted to further develop the MedMAB network. The aim was to better understand the similarities and differences between the member biosphere reserves in order to

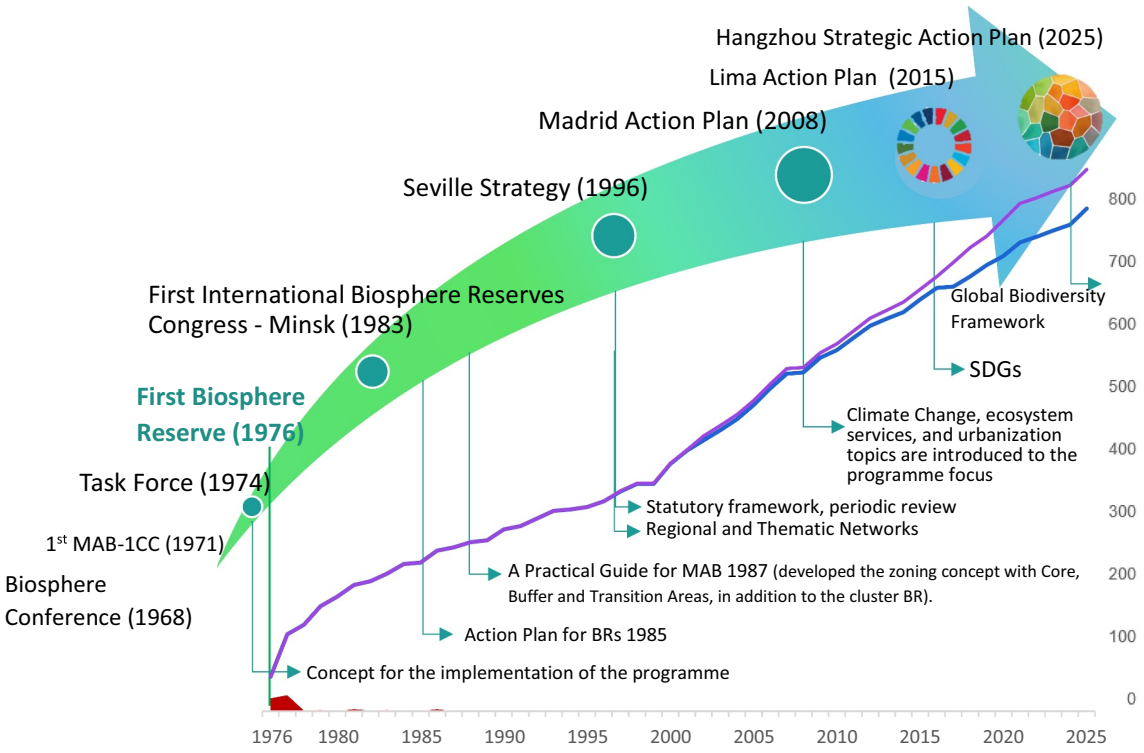

Figure 1. Milestones and phases of policy development over time (x-axis) in the UNESCO MAB Programme and the net number of Biosphere Reserves (y-axis) designated globally (blue line), the total number of designated Biosphere Reserves globally—including the withdrawn ones (purple line). The red area under the graphs indicates the withdrawn Biosphere reserves according to their designation year.

develop further network activities on this basis. The survey was distributed via email among the member biosphere reserves of MedMAB, and participants could answer in English, French or Spanish. All analysed data are thus manager responses. The UNESCOMED-Center received 40 responses from 38 Biosphere Reserves across 14 countries. A wide range of questions were asked regarding the following topics:

- General data: including surface area and number of inhabitants
- Management body: organization, activity, mechanisms for participation and decision-making, number of staff members
- Scientific committee: existence and activity
- SWOT analysis: self-reported strengths, weaknesses, opportunities and threats
- Recent research and transfer projects
- Cooperation with stakeholder groups like universities, NGOs, governments, enterprises
- Needs of the biosphere reserves
- Motivation for active cooperation in the MedMAB network

In the following section, we describe the data included in the analysis and explain their relevance as indicators for biosphere reserve development, orientation and functionality. We have created Figure 2 as a methods schematic to clarify the procedure of data analysis and interpretation. Specifically, we have examined data on the management bodies and their organizational structures. The type of organizational structure serves as an indicator of a biosphere reserve's alignment with current UNESCO policy. This is particularly relevant because, prior to the Seville Strategy, many biosphere reserves were designated as an additional label for existing national parks or other protected areas (Price 2002). In principle, a national park administration can successfully implement a biosphere reserve. In reality, national parks have a clearly defined legal framework at a national level and receive more recognition and resources than biosphere reserves, thus are likely to dwarf the biosphere reserve aspect and usually have a different and less multifunctional mandate (Aschenbrand and Michler 2021).

We have included the number of staff members in the analysis as an indicator of capacity and resource availability. However, it is critical to understand that the staff number of biosphere reserves must be interpreted carefully and in combination with information about the organizational structure. This is because national parks and other conventional protected areas usually have a much larger number of staff members that includes for example rangers and other staff members not necessarily directly concerned with implementing specific biosphere reserve policies. For example, some national parks designated as biosphere reserves may have extensive staff, but only a small portion are

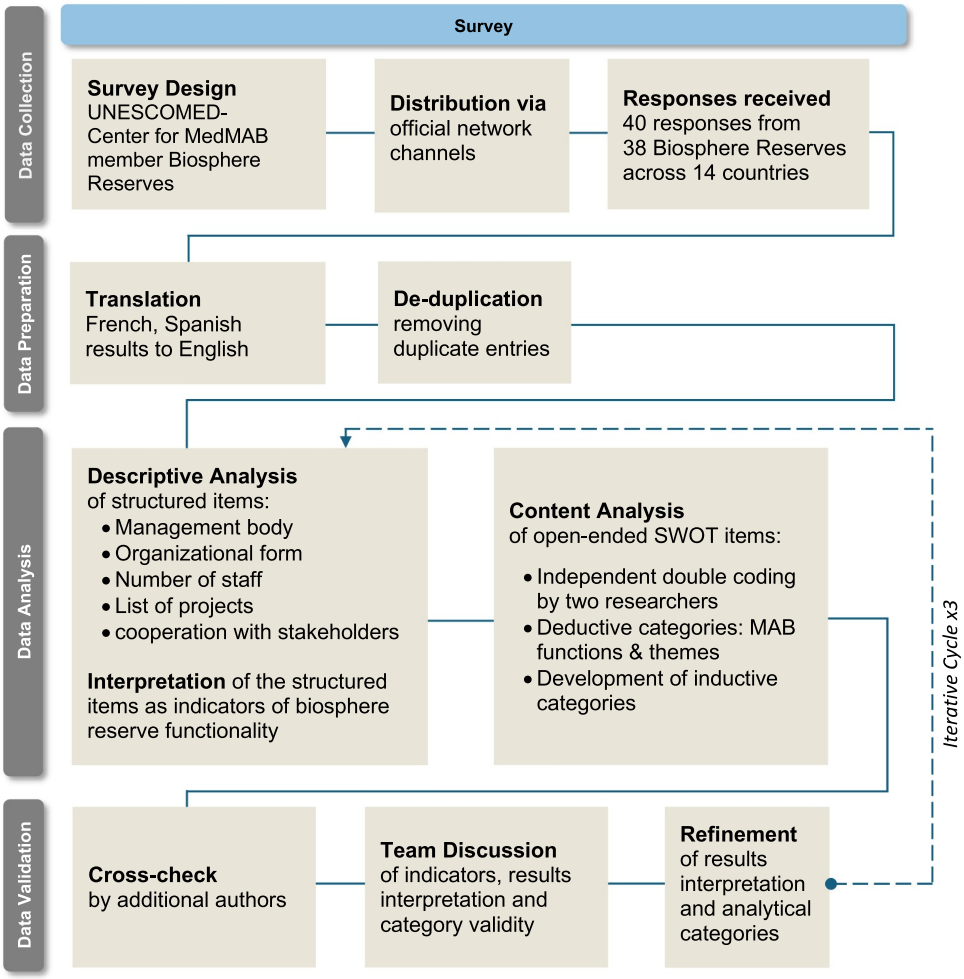

Figure 2. Methods schematic.

dedicated to biosphere reserve implementation. In such cases, the biosphere reserve is often treated as just one of many topics and does not guide the overall strategy of the protected area. We analyse research and transfer projects carried out in recent years by biosphere reserves as the thematic orientation of projects is an indicator of overall thematic priorities and work focus.

Additionally, we analyse the self-reported strengths, weaknesses, opportunities and threats (SWOT analysis). The SWOT analysis reveals which topics are important for management and therefore indicate the general thematic orientation of management. The open-ended SWOT responses were analysed using qualitative content analysis. All responses were translated to English before coding. However, for analysis, all statements were retained in their original language in a second column next to the translated statements so that the original statement could always be referred to during the analysis. To ensure reliability, all responses were double-coded by two researchers, and categories were refined through sequential comparison. Findings were reviewed by other researchers to ensure consistency and accuracy. The coding focused on identifying the relevance of each response to the three functions of the MAB Programme (conservation, development and logistic support). In particular, responses were assessed as to whether they reflected a conservation-oriented or/and development-oriented perspective. This approach aimed to explore how policy developments are reflected in the current practical implementation of the biosphere reserves. For example, if only nature conservation related topics are mentioned here, this can indicate a lacking implementation of the development function, which is reported to be common in many pre-Seville strategy biosphere reserves (Reed 2020). If local communities feature on the strengths and opportunity side, this can indicate successful implementation of the development side or at least efforts towards this end. While involvement of local communities was long part of the biosphere reserve concept, it became mandatory only with the implementation of the Seville strategy and statutory framework. We use quotes from managers to present the results. To preserve anonymity and maintain a neutral approach, the names of individual biosphere reserves have not been included into the results presentation; instead, we used codes (B2–B41) when quoting manager responses.

4. Results

Of the 38 biosphere reserves analysed, 12 were designated before 1995, prior to the Seville strategy, a major milestone in UNESCO MAB development (Ishwaran et al. 2008; van Cuong et al. 2017). Often, biosphere reserves designated before the Seville Strategy are referred to as first generation, while younger biosphere reserves are referred to as second generation (Bouamrane et al. 2020; Reed 2020). However, the data analyzed here show that structural changes in the implementation of UNESCO biosphere reserves become apparent starting in the year 2004. For this reason, we have identified 2004 as the point marking the shift from first- to second-generation reserves for the areas under consideration based on the empirical evidence. This evidence is explained in detail in the sections below. It consists of a comparison of organizational structures, resources in terms of staff members and self-reported strengths and weaknesses. These are aspects that we have identified as indicators of the different orientations and functionalities of biosphere reserves. Of the participating biosphere reserves, 15 were designated before 2004 and 15 after. Additionally, eight reserves designated before 2004 have undergone or are currently undergoing a reorientation process due to extensions or planned extensions. Fourteen of the participating biosphere reserves are located in the Arab states as defined by UNESCO and therefore part of the ArabMAB regional network of biosphere reserves, while 24 are located in Europe and are therefore part of EuroMAB regional network (Figure 3).

4.1. Evolution of organizational structures and priorities in biosphere reserves: from conservation focus to integrated sustainable development

Biosphere reserves of the first generation, designated before the Seville Strategy was adopted in 1995 and up until 2003, tend to be managed by governmental organizations that manage national parks or other protected areas at the same time—they tend to report a strong focus on nature conservation. Younger biosphere reserves, designated from 2004 onwards, are more likely to be managed by government organizations that have broader mandates on sustainable regional development. These can still be protected area organizations but more often regional parks that strive to integrate conservation and development (e.g. France and Italy). We also see associations that are more independent from governments managing younger biosphere reserves, for example, in Lebanon where the survey data confirm results obtained by Matar and Anthony (2020). In Spain, we see three more recently designated biosphere reserves (2013–2019) having organization forms dedicated exclusively to the management of the biosphere reserve and being based on municipalities. The nature conservation function is visible clearly across the two generation,s but the biosphere reserves designated after 2004 have a broader mandate on sustainable regional development additional to nature conservation. With regard to organizational resources,

Figure 3. Overview of the location of the biosphere reserves represented in the survey data.

the second generation of biosphere reserves reported the challenge of having insufficient financial and human resources more often than the older ones.

4.2. Resources: number of staff members

Second-generation biosphere reserves report fewer staff members in our sample. However, they more often report activities that align with all three functions of biosphere reserves as defined after the Seville Strategy. On average, first-generation biosphere reserves report around 40 staff members, whereas second-generation reserves report roughly nine. In the dataset, the number of staff numbers of the first generation ranges from 1 to 250, with a median of 32. The distribution is right-skewed, indicating that while most biosphere reserves operate with medium-sized teams, with a few employ substantially more staff. This pattern reflects a pronounced imbalance in staffing structures across the network, as reported figures often include national park personnel (e.g. rangers and administrative staff) within the biosphere reserve totals, even when they are not directly involved in biosphere reserve management.

For the second-generation biosphere reserves, the number of staff members varies between 0 and 49, with a mean of about 9 and a median of 2. The distribution is strongly right-skewed, indicating that while most biosphere reserves operate with very small teams (typically around two members). Only three biosphere reserves of the second generation reported substantially larger staff numbers. In these cases, respondents clarified that these higher figures refer primarily to national park rangers or state-employed personnel formally counted under the biosphere reserve but not directly engaged in its management. In contrast, several other responses highlighted the role of volunteers and community-based efforts, reflecting the participatory and locally driven character of many second-generation biosphere reserves. This combination underscores both the limited institutional capacity and the growing emphasis on community engagement in the governance of newer biosphere reserves.

The number of staff members remains an informative but complex indicator of biosphere reserve functionality and adherence to the UNESCO MAB strategy. What is clear, however, is that reporting practices differ substantially between generations: the majority of first-generation reserves report the entire staff complement of the associated protected area as biosphere reserve staff, whereas most second-generation reserves report only the core personnel directly involved in biosphere reserve coordination. Even in the few cases where national park staff were included in the count, respondents explicitly clarified that these employees were not actively working on biosphere reserve matters. This was illustrated by one participant, who noted that 'we do not have staff dedicated exclusively to the Biosphere Reserve, staff of the [name of the regional park] and its consultants work on an average one day a week in total [on Biosphere Reserve related topics]' (B2). Staff numbers indicate that the current MAB policy, which is based on participation and thematic integration, does not lead to the corresponding resources being available for implementation. State resources seem to be distributed rather within the administrative silos, while biosphere reserves, which try to overcome silo mentality and integrate policy fields, are too often left empty-handed.

4.3. Implementation of research and transfer projects

The analysis of recent research and transfer projects indicates a generational difference in thematic focus: among the first-generation biosphere reserves, 14 out of 15 reported research activities primarily oriented toward nature conservation, while five included sustainability, development or community-focused topics. Among the 15 second-generation biosphere reserves, nine reported nature-focused research projects and four focused on sustainability and development. However, second-generation reserves appear to be less research-oriented overall, as indicated by the answers regarding the existence of scientific committees (only five of the 15 newer biosphere reserves have a scientific committee, compared to 11 of 15 in older reserves) and a lower presence of university ties in these committees. However, in terms of transfer projects, newer biosphere reserves showed a stronger orientation towards sustainability and development, with nine out of 15 reporting such projects compared to only two out of 15 in the older group. Transfer projects aim at implementing measures for sustainable regional development and include, for example, innovating new approaches in agriculture and forestry, reviving traditional agricultural practices, marketing of regional products, or educational programmes in cooperation with local schools among others. While first-generation biosphere reserves tend to maintain stronger institutional research capacity and a conservation-dominant focus, second-generation biosphere reserves research projects are also mostly conservation related but additionally they engage in transfer projects for the implementation of community-oriented sustainability innovations (see Table 1).

Table 1. Results overview table.

Implementation Differences of UNESCO Policy among Mediterranean Biosphere Reserves		
	First generation (1976–2003)	Second generation (2004–2025)
Governance	Often managed by governmental organizations that manage national parks or other protected areas at the same time	Often managed by government organizations that have a broader mandate on sustainable regional development And: associations that are more independent from governments managing younger biosphere reserves
Resources	Ø 40 staff members, Median: 32 (range: 1–250)	Ø 9 staff members, Median: 2 (range: 0–49)
Scientific committee	11/15 reported having a designated scientific committee (8 functioning, 5 tied to a university)	5/15 reported having a designated scientific committee (4 functioning, 1 tied to a university)
Recent research projects	14/15 focused on nature conservation 5/15 included sustainability, development or community-focused topics	9/15 focused on nature conservation 4/15 included sustainability, development or community-focused topics
Recent transfer projects	7/15 focused on nature conservation 2/15 on sustainability, development or community	4/15 focused on nature conservation 9/15 on sustainability, development or community
Self-reported weaknesses and threats	*dominant themes: lack of resources, lack of public awareness* Additional themes are mostly conservation-oriented: Loss of biodiversity, ecosystem degradation, climate change, water shortage.	Additional themes range from ecosystem degradation, biodiversity loss and climate change to poor job prospects, out-migration, ageing of the population and governance fragmentation

4.4. SWOT analysis

Of the biosphere reserves analysed here, the first generation sees its strengths primarily in nature conservation. As these are often national parks or other government organisations, they tend to have a strong state mandate and competencies in the area of nature conservation, independent of their designation as biosphere reserves. In contrast, the second-generation biosphere reserves established from 2004 onwards often see their strengths in co-operation with local stakeholders in addition to nature conservation. Eleven of the 17 first-generation biosphere reserves identified nature conservation as their primary strength, while three highlighted cultural and development aspects. Conversely, among the 15 biosphere reserves designated after 2004, 10 emphasized nature conservation, and nine emphasized cultural or development elements.

When describing the weaknesses, there are some similarities between the two generations of biosphere reserves, but also differences. Both younger and older biosphere reserves frequently mention insufficient resources (human, financial, material) and a lack of public awareness of the objectives of the areas. The issue of rural depopulation is also mentioned by managers of both generations of biosphere reserves, although significantly more frequently by managers of the second-generation biosphere reserves. For example, a first-generation biosphere reserve cites 'the presence of a village with 4,500 inhabitants within' the protected area as its only weakness (B41), while a second-generation biosphere reserve lists a 'great depopulation of the territory' (B28) as a weakness and as a threat. Generally, the description of the weaknesses and threats in the younger biosphere reserves is thematically more extensive and ranges from 'poor job opportunities' (B13), 'decline in the livestock sector' (B27) to 'depopulation' (B21, B24) and 'ageing of the population' (B13), to governance fragmentation (Reported weakness, B25: 'Many organizations with responsibilities over different areas of the territory') and thus reflects the entire spectrum of problems of sustainable development of rural areas. With this broad range of topics, the managers also precisely describe the very broad mandate of the biosphere reserves since the Seville Strategy (Bouamrane et al. 2020; Aschenbrand 2022).

A weakness frequently reported by the second generation of biosphere reserves (2004–2025) is the lack of opportunity to take action because a large number of official authorities have responsibilities for issues relevant for the biosphere reserve function but do not recognize or use the biosphere reserve for guiding regional development (B10, B11, B12, B24, B25). This can be addressed as governance fragmentation (Biermann and Kim 2020) and is rooted in the integrative approach of biosphere reserves, which promises to combine conservation and development (Aschenbrand and Michler 2021). With the broad mandate that biosphere reserves have, it is impossible (and undesirable) to combine all necessary authority in a biosphere reserve management body. If biosphere reserves instead see themselves as bridging organizations (Olsson et al. 2007), they can bring together actors who are necessary for participatory and socially sustainable ecosystem management (Barraclough et al. 2023). By identifying common goals and challenges, they can create new perspectives on the development of a landscape (Biggs et al. 2010). Thus, the involvement of local communities and their politics is not only beneficial for the local communities—it is absolutely necessary for any biosphere reserve in order to fulfil its functions. However, biosphere reserves need to have a standing in order to be perceived as relevant actors in a governance system (Klaver et al. 2024). In this context, managers of second-generation BR highlight the lack of legal

recognition as a weakness: 'The reserve does not have legal status' (B12). In practice, we even see some second-generation biosphere reserves that are represented by only one or two persons, who furthermore report to have little connection to official state or municipal authorities that have a state mandate to manage the landscape. These participants report their biosphere reserves to be not functional (B10: 'No effective management structure, no genuine transboundary cooperation, no action plan, no transboundary management plan'. B34: 'BR not operational').

4.5. Extension of biosphere reserves as a driver for adapting to UNESCO policy change

Eight biosphere reserves out of 38 would be categorized as first generation based on their date of designation but underwent or are currently undergoing a process of extension. The extension process is almost as complex as the original application to be designated as a biosphere reserve. Those biosphere reserves seem to reflect the UNESCO policy of the extension date so that we classify all of them from a functional perspective as second-generation biosphere reserves. Their organizational structure includes government authorities as well as municipal authorities and associations. All reports to have elaborate mechanisms for local participation and scientific cooperation in contrast to many first-generation biosphere reserves. Their reported SWOT analyses reveal a focus on community engagement and sustainable development issues additional to nature conservation, frequently referring to broader topics of economic development and livelihood like rural depopulation and sinking average wages.

5. Discussion

It has long been acknowledged that the Seville strategy and the implementation of the Statutory Framework in 1995 have been pivotal for the UNESCO MAB Programme (Price 2002; Ishwaran 2012; Bridgewater 2016; Bouamrane et al. 2020). Our data show that almost three decades after passing these milestones, we still see differences between biosphere reserves implemented before and after the Seville Strategy. Newly designated biosphere reserves have endorsed the MAB Programme's policy changes, while first-generation biosphere reserves have had limited success. This finding confirms results from van Cuong et al. (2017) who analysed the success of biosphere reserves based on an expert survey.

Our data also indicate that there was a considerable timelag between the adoption of new policy at the UNESCO level and the implementation of this policy in newly designated biosphere reserves. Information about the existence and extension of such a timelag in the implementation of new policy was previously not mentioned by authors dealing with the topic (Ishwaran et al. 2008; Bridgewater 2016; Bouamrane et al. 2020). We can confirm our hypothesis that biosphere reserves, at least to a certain degree, represent the MAB policy that was in place when they were originally designated.

First, we want to discuss reasons that can explain the MAB Programme's limited adoption of policy changes in early designated sites. Our data suggest that organizational structure and governance systems are key determinants of the biosphere reserves behaviour. Prior to the introduction of the Seville Strategy, the practice of the MAB program often consisted of additionally designating existing protected areas as biosphere reserves (Price 2002). However, existing organisations have their own logics, cultures, objectives and tasks (Khaw et al. 2022; Scaliza et al. 2022). Organizational change and innovation are often driven by changes in the organizational environment, but this only applies if the specific changes are perceived as relevant (Damanpour and Gopalakrishnan 1998). Hoffman et al. (2022) find that most international treaties 'fail to produce their intended effects'—especially if they do not have enforcement mechanisms. As the UNESCO MAB Programme does not have an enforcement mechanism, in the event of policy changes on the UNESCO level, the management body might often primarily continue with the tasks legally defined by the state and consider how it can justify its compliance with new MAB criteria, which are not legally binding—and hence less relevant.

For a national park in state ownership, the implementation of the MAB Programme with its demands for multisector integration, community involvement and shared decision-making may mean a fundamental strategic reorientation (Price 2002), which would perhaps be desirable in many places, but has apparently rarely been implemented. The data collected tends to indicate that, from the perspective of national parks and state administrations, the biosphere reserves policy is perceived as one among many tasks that is often not given the highest priority (Aschenbrand and Michler 2021).

Second, we want to highlight that many younger biosphere reserves are also facing serious problems with implications for the UNESCO MAB Programme as a whole. The governance systems of the second generation of biosphere reserves are more local and often based on municipalities and sometimes associations. According to our data, but also according to existing literature (Olsson et al. 2007; van Cuong et al. 2017), these biosphere reserves apparently have a closer involvement of local communities as required by the MAB policy. However, some obviously operate under precarious conditions and have less than five, sometimes only one, staff positions. With such marginal resources, it is

impossible to even begin to meet the high ambitions of the MAB Programme. The concept of governance fragmentation, as developed by Biermann and Kim (2020), is helpful to frame the situation: increasing thematic integration as promoted by the MAB Programme necessarily increases governance fragmentation (Aschenbrand and Michler 2021). A review by Jordan and Lenschow (2010) documents the challenge of implementing environmental policy integration in general—a concept whose implementation falls short of expectations and where there are few best practices. While mechanisms to address governance fragmentation and create integration of policies exist in some biosphere reserves (Olsson et al. 2007; Biggs et al. 2010), systematic approaches need to be developed, scaled up and pushed to the centre of the MAB programmes quality management.

Third, the MAB Programme is an intergovernmental programme, but its implementation is supposed to be local. Since the adoption of the Statutory Framework in 1995, it has a built-in bottom up approach, or at least control against top-down-only approaches (Reed 2019). However, the local level does not communicate directly to the UNESCO level. As an intergovernmental programme, the MAB Programme is implemented nationally through national MAB committees. The national MAB policy mediates between the international and the local level and therefore plays an important role in the speed and seriousness with which UNESCO policy is implemented nationally (Schliep and Stoll-Kleemann 2010). Different degrees of participation of the UNESCO member states in the UNESCO MAB Programme are clearly visible and will have an effect on biosphere reserves functionality and adherence to UNESCO policy. Cooperation between biosphere reserves needs to be strengthened by network structures to allow more direct exchange between biosphere reserves, enabling peer-to-peer learning, transboundary cooperation (Taggart-Hodge and Schoon 2016) and truly creating a functional world network of these sites and their communities.

Fourth, the authors want to address future chances for strengthening the implementation of the MAB policy in biosphere reserves. Like previous authors (Price et al. 2010; Reed and Egunyu 2013), we observe that quality management like the mandatory periodic review process is effective and should be expanded. Most effective in this regard is the extension process, which is not a quality management measure but seems to have a direct effect, acting as a policy update for participating biosphere reserves. The mandatory periodic review process should therefore be strengthened and its quality improved—to determine compliance as well as to create learning opportunities (Reed and Egunyu 2013). It should be able to identify and address lack of community engagement in many first-generation biosphere reserves, and it should also identify and address lack of resources in many second-generation biosphere reserves. Both are absolutely important for the success of the UNESCO MAB Programme.

6. Conclusions

The UNESCO MAB Programme strives to create regional units of sustainable development—biosphere reserves. The Seville Strategy implemented in 1995 marks a pivotal point in programme development. It is still justified to speak of first- and second-generation biosphere reserves, as the empirical data still show differences between biosphere reserves that were designated before this pivotal point and those that were designated later. A determined shift towards community involvement also brought a shift towards governance structures that are no longer implemented at the state level, but rather at the municipal level. Additionally, a focus on integrative policy increased thematic integration but, as a consequence, also increased governance fragmentation, causing a need for effective mechanisms addressing this issue. These changes from first- to second-generation biosphere reserves have been accompanied by a lack of resources among many biosphere reserves of the second generation. In some cases, biosphere reserves have so few resources that a full implementation of the ambitious MAB Programme is not even conceivable. Some extensions of biosphere reserves give cause for hope. It is evident that the expansion process acts as an effective quality management programme and policy update. It can therefore be concluded that the MAB Programme succeeded in promoting its development on the newly designated Biosphere Reserves at the time but had limited success in achieving the changes over in previously designated sites.

Disclosure statement

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