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Nature-based Solutions in the Mediterranean Region: A look back and moving forward

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ABSTRACT

Urbanization and agricultural intensification have an important impact on biodiversity around the Mediterranean basin. One response has been the take-up of the concept of Nature-based Solutions, notably promoted by the International Union for Conservation of Nature. Although the term is widely employed, there is great discrepancy in the definition, use, and intended biodiversity and/or societal impacts. We conducted a literature review on the state of the art of Nature-based Solutions in the Mediterranean basin, identifying the obstacles concerning their implementation and highlighting recommendations for overcoming these difficulties. The study analysed over 200 documents including scientific articles, guidelines and policy documents. Recommendations were grouped into categories (Governance, Funding, Integration, and Technical aspects) and key messages were identified. The results showed that interdisciplinarity and participative practices are essential and that systematic and political changes are needed. Selecting and adapting Nature-based Solutions to fit specific social and ecological contexts and responding to trade-offs and inequalities were highlighted as prerequisites. Public communication and funding schemes were also important levers for improving implementation. The results show that although Mediterranean-specific NbS remain an emerging topic in scientific literature, a broad range of other types of documents, including international academic articles, can be useful for local practitioners.

1. Introduction

Studies such as the Living Planet Index have been used to analyse the state of biodiversity around the world. This tool was applied to Mediterranean species and shows that negative trends have continued between 1993 and 2016 (Galewski et al., 2021). Biodiversity has been highly impacted by human-induced changes around the Mediterranean basin. The most important pressures and threats are linked to dominant land use and consumption and production systems, notably urbanization and agricultural intensification (Underwood et al., 2009). In order to combat this decline, the International Union for Conservation of Nature (IUCN) proposed the concept of Nature-based Solutions (NbS) in 2016. This concept has gained momentum over the last decade both in terms of academic research and on the ground conservation (Palomo et al., 2021). Although the term is widely employed amongst practitioners, scientists, and funding institutions, there is great discrepancy in the definition and use. That might owe to the fact that it does not sit easily with scientific research approaches, which have not traditionally concerned themselves with identifying solutions (Hanson et al., 2020).

Nevertheless, many organisations promote the concept of NbS directly as an approach to nature conservation (IUCN, United Nations Environment Program and WWF), and others frame the concepts of NbS indirectly through notions of incorporating ecological restoration for biodiversity, climate change and the interactions between nature and society (Society for Ecological Restoration). In this article we use IUCN's definition of NbS "as actions to protect, sustainably manage and restore natural or modified ecosystems, which address societal challenges effectively and adaptively, while simultaneously providing human well-being and biodiversity benefits" (Cohen-Shacham et al., 2016).

Over 160 countries have identified NbS as a key component in their Nationally Determined Contributions in support of the Paris Agreement. Despite these well intentioned plans, on the ground delivery is quite diverse (Seddon et al., 2020) and the implementation has shown mixed results (Albert et al., 2021). Much of the literature suggests multiple benefits of NbS including stakeholder and citizen participation or collaboration (Ferreira et al., 2020), reduction of societal challenges (Davies et al., 2021) and the potential for stimulating economic development (Nesshöver et al., 2017). NbS have been promoted extensively in

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both urban areas (European Commission. Directorate General for Research and Innovation, 2021) and areas with minimal human activities (Waylen et al., 2022) but the concept, interpretation and implementation remain ambiguous (Sowińska-Świerkosz & García, 2022).

Many conservation activities and projects are limited to protected areas or on a specific ecosystem such as wetlands or forests. This approach has shown its limitations and a more area-based conservation method is recommended (Maxwell et al., 2020). Connections and interactions amongst different ecosystems are critical to maintaining ecological functions and their benefits for nature and humans (Butler et al., 2022). The multi-ecosystem approach is the basis of a new consortium that was developed for the Mediterranean Region. The Mediterranean Biodiversity Consortium (MBC) was established in 2021 and is composed of regional environmental actors that work around the Mediterranean basin for nature conservation. The founders of the consortium are MedWet (the Mediterranean Wetlands Initiative of Ramsar), MedPan (Mediterranean Protected Areas Network), PIM (Mediterranean Small Islands Initiative), Tour du Valat Research institute for the conservation of Mediterranean wetlands, AIFM (International Association for Mediterranean Forests) and IUCN-Med (IUCN Centre for Mediterranean Cooperation), with the support of Conservatoire du littoral (French Coastal Conservation Agency) (<https://www.medconsortium.org/>). The objectives of the MBC are to effectively protect and restore Mediterranean biodiversity, identify, implement and promote NbS, and mobilise and support local communities to better conserve and manage nature. To pursue these objectives, the MBC conducted a literature review to determine the state of the art of NbS in the Mediterranean basin, identify the obstacles concerning their implementation and make recommendations for overcoming these difficulties. Two features distinguish this approach from other literature reviews of NbS in the Mediterranean (see Motta Zanin et al., 2024). First, it is not limited to one ecosystem type or societal challenge; and second, it draws on both scientific sources and documents identified as relevant to practitioners, thus striking a rounded perspective informed by academic and non-academic perspectives.

It is important to note that in doing so, the objective was not to identify all cases of actions to manage, protect or restore ecosystems that could be considered as NbS, but rather to seek out those which are

explicitly described as such. This research serves to better understand how widely the concept of NbS has been adopted, and to identify key features of projects which could be adapted and contextualized to improve conservation practices around the Mediterranean basin.

2. Materials and methods

To assess the state of the art of NbS in the Mediterranean, two primary sets of documents were consulted to create a comprehensive literature review. The first was the collection of resources relating to NbS that MBC partners already had at their disposal. The second was literature on NbS from academic sources and scientific journals. The approaches to both sets of documents are described below (Fig. 1).

2.1. Commonly used MBC documents

For the partners' documents, desktop research was initially conducted to explore the websites of the partners and identify NbS-related documents. Where the partners' websites had dedicated pages for resources or documents, these were searched, using "nature-based solution", "NbS", "solutions fondées sur la nature" or "SfN" (some partners' websites and documents were in French) as search terms. In parallel, all project partners were asked to upload to a designated folder any documents on NbS that they had found useful. These could include, but were not limited to publications, practical tools, policy papers and training presentations. 81 resources were collected (a full reference list can be found in Supplementary material A). Some of the documents were included several times as they were found in different languages. These were kept in the list, however, and not considered as duplicates because they were likely to reach different audiences and therefore broaden the reach of the key messages in the documents. The resources were recorded in a spreadsheet which specified the principal objective, ecosystem, type of document, and targeted readership (the entries for these categories can be found in Supplementary material B). The documents were analysed according to each of the categories to determine the frequency and percentage of each category. All the documents were then reviewed to identify the main difficulties in implementing NbS and key recommendations. The key difficulties and recommendations were

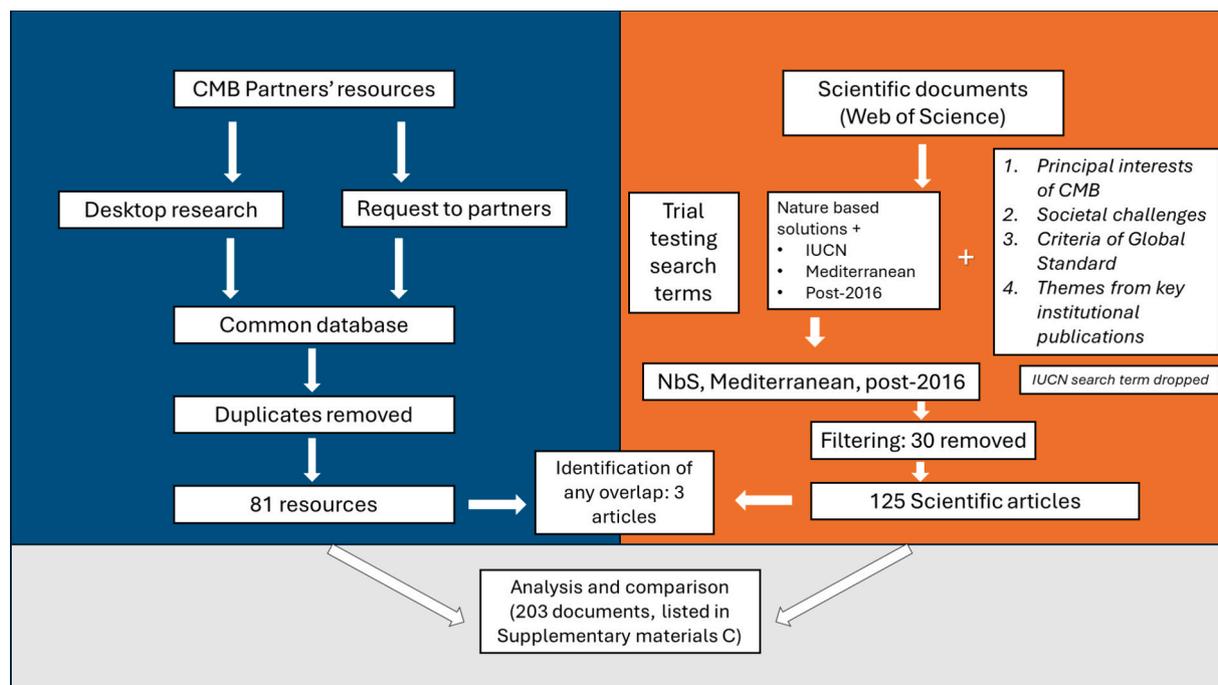


Fig. 1. Process for identifying documents for the literature review on Nature-based Solutions in the Mediterranean.

then classified and grouped into four categories (Kitchin & Tate, 2000). The categories were: Governance, Funding, Integration, and Technical aspects.

2.2. Web of Science articles

A second literature review was undertaken to identify academic articles using the academic search engine Web of Science (WoS). WoS is a paid-access search engine that draws on six multidisciplinary online academic databases for its Core Collection, updated by an editorial process to index new publications as they are released (Clarivate, 2025). As such, its contents are less instantaneous than automatic academic search engines like Google Scholar. However, the review conducted by WoS aims to filter out predatory journals, aiming for higher quality search results. A list of search terms was developed based on the author's previous engagement with NbS concept, key related literature, and experience with projects using the concept. As the focus was on the state of art across all academic research pertaining to NbS in the Mediterranean rather than limited to a particular set of authors or publications (or societal challenges), the searches were made based on articles' "topics". Thus, if a match was found between the search term and an article's title, abstract or keywords, that article was included in the search results.

The search terms were tested using WoS and refined iteratively based on the usefulness of their results until a list was settled on that could be informative. Along with NbS, other keywords used in searches were based on four sources: 1) Principal interests or knowledge gaps noticed by the MBC regarding NbS. 2) Societal challenges mentioned in the IUCN report *Nature-based Solutions to address global societal challenges* (Cohen-Shacham et al., 2016). For the societal challenges, an additional challenge – environmental degradation and biodiversity loss – was also added because this was featured in the Golden Standard report after public consultations on the Standard (IUCN, 2020). 3) NbS Criterion from the IUCN Global Standard Report (Andrade et al., 2020). 4) A remaining set of themes related to NbS based on the review of three additional institutional documents. The full reference list of these elements and string queries can be found in [Supplementary Materials B](#). An extra filter was used to evaluate the number of articles corresponding to these elements to see if there was a thematic focus on Mediterranean-based NbS literature. In addition, another filter selected articles released in or after 2016, to correspond with the IUCN's 2016 published definition for NbS, mentioned above. We trialled "IUCN" as a search term for even further consistency; however, this was unhelpful for reasons explained below. Thus while we recognise that the IUCN's definition would take time to appear in academic work after 2016, NbS would have been more prominently on the agenda of policy and research projects from 2016 because of the definitive report. The intention was to select results for the search terms that yielded between 100 and 500 results, interpreted as striking a balance between precision and generality in their scope. These documents were downloaded into an Excel file with their abstracts. All documents were also analysed by discipline.

When searching for results combining NbS, with the IUCN, the Mediterranean, and a post-2016 criteria, only 29 results were found (date of search: 31 March 2025). The search was therefore broadened to drop the Mediterranean search term, but still only came back with 29 results. However, when searching *with* the Mediterranean term but *without* either the IUCN or post-2016 criteria, 155 results were found. All of these were published in or after 2016, making the post-2016 filter redundant. Considering the low results when searching with IUCN as a search term, it was decided that the post-2016 criteria would be used instead to approximate consistency with the IUCN's definition as this definition was broadly diffused in conservation networks around the Mediterranean basin. We acknowledge that there could be many articles relevant to the NbS definition prior to 2016, but they would have used other terminology and thus cannot be said to have necessarily adopted NbS and its implications specifically. This literature review therefore did not include these articles. For the Mediterranean literature, a second

filtering exercise was done. Based on the abstracts, articles were included if they involved an aspect of biodiversity conservation or restoration, with a co-benefit, consistent with the IUCN's definition of NbS. Articles were only excluded if they were either too out-of-topic for nature conservation (for example articles dealing exclusively with circular economies in cities) or too technical (such as papers speaking to a niche or discipline-specific interest like using a certain alga to treat plastic pollution) to convey messages that would be helpful to consortium practitioners. For instance, several articles discussed green walls or building-specific rainwater harvesting systems, which, while representing isolated cases of introducing biodiversity to adapt to climate change, are less concerned with entire ecosystems. Other articles discussed highly technical and jargon-heavy techniques, for instance for measuring soil quality or carbon sequestration of a particular type of species. And some referred to 'Mediterranean' climates but actually covered areas such as California or Australia. 30 such articles were removed.

To identify where research on NbS particular to the Mediterranean stands with respect to research globally, an equivalent search was carried out (NbS, post-2016, with each of the elements in [Supplementary material B](#)), but without the criteria of the Mediterranean (date of search: 31 March 2025). In total, 4,419 articles were found relating to NbS post-2016; however, this number was considerably reduced by adding the additional elements in [Supplementary material B](#). Consulting literature from outside the Mediterranean was considered beneficial for this exercise, as certain members of the MBC had listed non-Mediterranean scientific articles when asked for documents which they found useful.

3. Results

The results are presented here in three sections: firstly, the results from the MBC documents, secondly the WoS searches and lastly, a comparison of the two databases.

3.1. MBC documents

All of the 81 documents were produced between 2014 and 2024, with an average date of 2020. Out of the 81 documents, 60 % were directly concerned with NbS while 40 % covered other related topics (primarily related to climate change, climate adaptation and restoration). These related documents addressed the subject of NbS indirectly or using other terminology. 60 % of the documents dealt with a specific ecosystem type, with wetlands and coastal zones being the most frequent ecosystem addressed. 40 % of the documents dealt either with multiple ecosystems or did not specify a specific ecosystem ([Fig. 2](#)).

The different documents were further classified by objective and the most common objective was Communication and awareness-raising

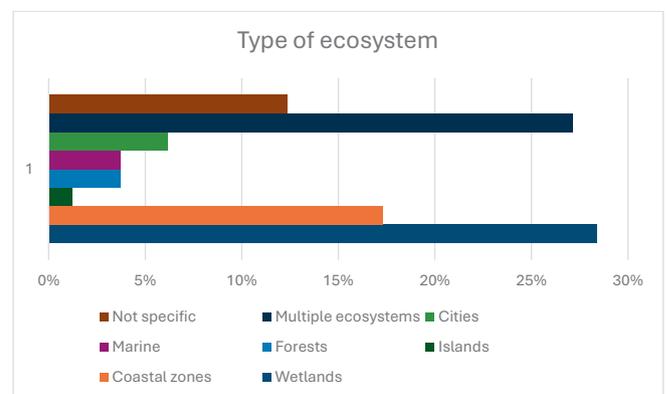


Fig. 2. Percentage of NbS documents classified according to type of ecosystem addressed.

followed by Implementation, Governance, Technical expertise, and Planning/design. Practical guides and Scientific publications were the most common document type, followed by Policy documents and Case studies (Fig. 3).

A review of all the documents collected allowed us to identify the main difficulties that were identified when implementing NbS projects and activities. The principal difficulties encountered were related to: Governance (land tenure and acquisition of property, limitations in legislation and lack of effective protected area coverage, insufficient governance structures), Funding (incapacity to implement long term monitoring due to lack of funding over time and limited funding for studies), Integration (abandonment of traditional land management systems, mobilization of actors, conflictual dialogue between stakeholders), and Technical aspects (assessing climate change impacts for developing adaptation measures, transforming research findings into concrete management propositions, technical capacities on the field).

We reviewed each document to identify the recommendations and grouped them into the same categories as the difficulties: Governance, Funding, Integration and Technical aspects (Table 1).

3.2. Web of Science results

In both the global search and the Mediterranean-specific search, the most represented discipline for articles was “Environmental Sciences” (which in the WoS classifications, does not comprise other disciplines like Plant Sciences, Water Resources, Environmental Studies or Ecology). For the global search, Environmental Sciences comprised 2,247 out of 4,419 articles (51 %); this is roughly mirrored in the Mediterranean search, where it comprised 56 out of 125 articles (45 %). Certain IUCN societal challenges, namely climate change, disaster risk reduction, water security, and environmental degradation and biodiversity loss are represented in the most common disciplines (Ecology, Engineering Environmental, Water Resources, Environmental Studies, Green Sustainable Science Technology and Geosciences Multidisciplinary). However, the other IUCN societal challenges – food security, health, and socio-economic development – did not explicitly align with the ten most represented disciplines for either the Mediterranean or the global search. As long as this remains the case, there will be an underrepresentation of certain “societal challenges” within the academic research, despite these challenges potentially being more pressing in certain contexts. Behind the broadness of the NbS concept, we therefore see a unevenness across which challenges in society are given more attention than others.

When adding the elements mentioned in Supplementary material B, the search results for the Mediterranean decreased considerably. The elements within this set which yielded the most results were: exclusion of urban or cities, climate change, ecosystem services, resilience, conservation, equitable balance of trade-offs and co-benefits, stakeholder or citizen participation, biodiversity loss or degradation, and human

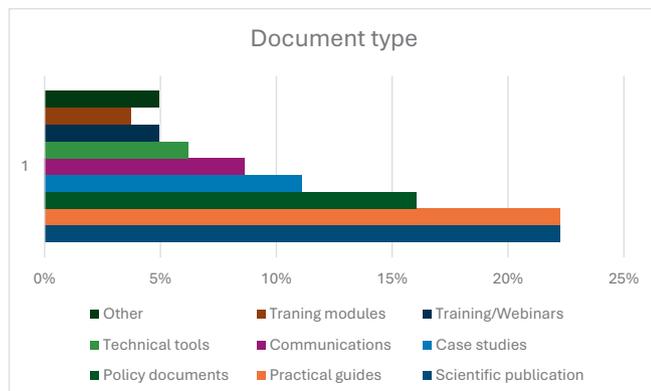


Fig. 3. Percentage of NbS documents classified according to type of document.

Table 1

Recommendations for NbS according to categories (Governance, Funding, Integration, and Technical aspects).

Category	Recommendations
Governance	<ul style="list-style-type: none"> • Encourage multi-stakeholder governance: governments, private companies, local communities, NGOs and international organizations should act in a coordinated way, • Work in partnership, • Awareness raising is essential, • Each state should integrate NbS in their Intended Nationally Determined Contribution and other policy documents, • It is essential to create and maintain effective governance structures, • NbS should be based on a shared vision developed by appropriate stakeholders, • Regional and networking initiatives are essential for sharing lessons and scaling up, • Management needs to be ensured over time, • Intersectoral cooperation and exchange is a key prerequisite for successful NbS
Funding	<ul style="list-style-type: none"> • Use both public and private funding resources, • Reinforce the use of payment for ecosystem service schemes
Integration	<ul style="list-style-type: none"> • NbS should be selected and adapted to each specific context, • Communication is essential at different scales (from within the project team to the large public), • Creation of socio-economic opportunities can increase the buy-in for local populations, • Trust and capacity can be built through pilot projects, • It is essential to ensure equitable tradeoffs between risk and benefits
Technical aspects	<ul style="list-style-type: none"> • Ensure connectivity of marine/terrestrial systems using a territorial (or landscape) approach, • Take into account climate change scenarios when planning NbS, • Continue studying ecosystem functions and ecological restoration to find the best solutions, • Promote agro-ecological studies and implementation, • Evaluate the cost-benefits of NbS and other alternative solutions, • Use adaptive management, • Keep the activities simple and proportionate

health. The remaining key phrases generated less than 10 results each. By only using the terms with more than 10 research results allowed for the prioritisation of articles according to themes, but this could have possibly eliminated some very interesting articles or topics. Several key phrases in the institutional literature (including gender and poverty), did not result in any articles for the Mediterranean search (Table 2). These underrepresented topics are not included in Table 2 for brevity, but their absence indicates a significant literature gap in NbS, at the Mediterranean and international scale. The underrepresented themes (e. g., food security, gender, poverty) could be significant for NbS implementation because they topics that of essential importance to local communities and could be limiting factors for NbS buy-in.

The results for the global search are included alongside the Mediterranean search in Table 2 for reference. Those phrases for which less than three articles were found were excluded from this table. The appearance of specific topics in relation to NbS internationally is consistent with academic articles focused specifically on the Mediterranean.

3.3. Overlap between academic literature and the Consortium's documents

Of the 11 academic articles found in the MBC's documents, 8 were identified using the search parameters of NbS, since 2016. When restricted to the Mediterranean, 3 academic articles were identified which had also been a part of the MBC's documents.

The scientific articles reflected a relatively balanced split between urban and non-urban areas, with about 42 % of articles addressing explicitly urban challenges. For specifically rural areas, NbS for

Table 2
Results for key phrases for NbS in both the Mediterranean and Global search.

Key phrase	Mediterranean search	Percentage	Global search	Percentage
<i>Total</i>	125	100 %	4419	100 %
Outside of cities	70	56 %	2483	56 %
Climate change	63	50 %	1804	41 %
Ecosystem services	37	30 %	1281	29 %
Resilience	25	20 %	835	19 %
Conservation	23	18 %	728	16 %
Equitable balance of trade-offs and co-benefits	19	15 %	830	19 %
Stakeholder/citizen participation	19	15 %	790	18 %
Environmental degradation and biodiversity loss	18	14 %	564	13 %
Human health	17	14 %	723	16 %
Economically feasible or viable	7	6 %	182	4 %
Scale and design	6	5 %	318	7 %
Adaptive management	4	3 %	149	3 %
Inequality	4	3 %	70	2 %
Context-specific	3	2 %	113	3 %
Economic and social development	3	2 %	228	5 %
Food security	3	2 %	100	2 %
Livelihoods	3	2 %	146	3 %

addressing for agriculture ($n = 24$) and wildfire prevention ($n = 8$) were the two most common themes. The key messages from the scientific articles were generally focused on a specific type of NbS, with the majority of articles dealing with some form of assessment of an NbS project. The articles can be classified into: i. articles which specified *criteria for success* for NbS to be effective, ii. articles which proposed in-depth *evaluation* methods for NbS, iii., articles which suggested how to *guide NbS implementation*, and iv. articles which conducted a *review of NbS* (knowledge, information-sharing and/or perceptions) (Table 3).

4. Discussion

Despite the fact that the consortium partners are all dedicated to working with NbS for over a decade (both on the field and through various training programs), there was very little overlap between the documents found in the MBC database and that of the WoS search. When comparing the two sets of data for the NbS literature review, there are clear differences between the scientific literature and the more commonly used documents by the consortium partners. Although both databases included documents linked to other key topics (including climate change and ecosystem restoration), the MBC documents were more heavily focused on communication/awareness raising and implementation, with more emphasis given to guides and scientific documents over case studies. On the other hand, the majority of the WoS documents were scientific articles related to specific case studies and technical assessments of NbS implementation and evaluation. Although most of the MBC documents did focus on specific ecosystems, there were still many more documents in the MBC database that had a multi-ecosystem approach as compared to the WoS database. The differences between the two databases could highlight distinct perspectives between on the ground implementation and scientific research. The MBC database represents more the interests and affinities for on the ground implementation whereas the WoS documents target a more scientific community interested in developing and producing knowledge. This information is extremely important but must be repackaged in a way that is more user friendly and accessible to a different audience if it is to be applied for conservation. Furthermore, the academic literature could apply more methods grounded in knowledge coproduction to

Table 3
Classification and messages derived from NbS scientific articles.

Types of article	Key messages
Criteria for success	<ul style="list-style-type: none"> • Activities should consider large-scale NbS networks (for instance for flood management) and non-NbS mechanisms such as conventional engineering • NbS should respond to the conditions, constraints and objectives specific to the site, as well as the ecological conditions of the region • NbS should be informed by existing inequalities and uneven distribution of benefits • NbS should integrate public participation and cooperation with multiple stakeholders, social values, needs and interests • NbS should be implemented alongside knowledge co-creation processes • NbS need to be supported by policy and advances in financing • NbS should be based on scientific foundations and evidence • It is important to integrate the lessons learnt from other NbS, appreciating the contexts that determined outcomes elsewhere
Evaluation	<ul style="list-style-type: none"> • Evaluation and monitoring are essential for NbS implementation and scaling-up • Technical recommendations are suggested for evaluating and/or comparing the effectiveness and limits of NbS for multiple outcomes including soil health improvements, graywater treatment, reduced risk, and water quality • Recommendations are given for effective monitoring (biodiversity, ecosystem services) • It is essential to evaluate ecological trade-offs of NbS
Guide NbS implementation	<ul style="list-style-type: none"> • How to value the usefulness and practicality of NbS for urban design • Methodological recommendations to compare NbS to non-NbS flood risk typologies • Methodologies are suggested to measure ecosystem services rendered by NbS • Technical tools and methodologies are given to identify sites for NbS • Exchanges and capitalization of learning are essential to help guide co-design and stakeholder support
Review of NbS	<ul style="list-style-type: none"> • Sharing of case studies of expert perceptions of NbS • Techniques and recommendations for improving public communication around NbS • There is still a lack of information and detail on specific NbS types • More interdisciplinarity is recommended to fill knowledge gaps

production research that is relevant to practitioners and actionable.

The literature review highlighted obstacles related to the implementation of NbS. Many of the documents focused on governance difficulties, which is in line with previous studies on conservation and restoration (Cortina-Segarra et al., 2021). The most pressing governance issues included complex land tenure conditions, lack of appropriate legislation and weak governance structures. Different recommendations were suggested such as putting in place or enhancing multi-stakeholder governance systems that involve governments, private companies, local communities, NGOs and international organizations. These participative processes are essential for stakeholder buy-in (Young et al., 2013); however, they are often linked to project funding, which can limit sustainability and cause frustration over time (Kiss et al., 2022). Improving existing governance structures or setting up new structures is seen as an essential step to improve NbS implementation, but these structures must take into account the local contexts (Terrisse et al., 2025) as there is not a single solution for every situation.

There was a strong overlap in governance recommendations between the MBC documents and the scientific literature. Some of the MBC documents included step-by-step guides for improving governance. These guides can be useful tools for site managers and project leaders but participation is a process and not just a set of activities to be checked-off (Reed, 2008). Participative governance processes provide

opportunities to develop a shared vision and build trust that is indispensable for working together. Malamataris et al. suggest using this process as a co-creation tool to improve NbS impacts (Malamataris et al., 2025) rather than an objective itself.

Hanson et al.'s (2020) literature review, in which a minority of NbS publications reflected stakeholder engagement, remains a challenge. Many of the different documents for this study highlighted that the role of stakeholder involvement is central to NbS implementation (Nelson et al., 2020). The importance of stakeholder mapping and incorporating social scientists in developing and implementing NbS has been recommended in some of the guides and case studies. This process allows for the definition of stakeholder roles and implication of the different types of actors (e.g., governmental agencies, NGOs, private sector, local communities). This could reduce some of the eventual hurdles and conflicts in project implementation and help increase the chances of sustainable actions (Geijzendorffer et al., 2019). The literature suggests that there is a disconnect between top-down approaches (the UN decade for nature restoration for example) and bottom-up conservation approaches (Mediterranean Wetlands Alliance Green-Light project). Despite the potential for collaborative learning and reducing conflicts (Ferreira et al., 2020), a lack of stakeholder participation in NbS internationally has been a barrier to their achieving real participation and addressing equity (Melanidis & Hagerman, 2022; Anguelovski & Corbera, 2023). Indeed, potential tensions between ecological, social and economic tensions – when not addressed – can have negative and unjust outcomes. Using social science approaches to NbS can help reinforce and bridge the two approaches of top-down and bottom-up (Palomo et al., 2021).

The barriers linked to funding were highlighted in many of the documents and scientific articles, showing the weaknesses of project-based activities that have only short to middle term life spans and the lack of funding to ensure essential feasibility studies and long-term monitoring. Lack of funding for studies greatly jeopardizes the real potential to put in place adaptive management practices (Salafsky et al., 2001). Different documents recommended that one possibility for overcoming the funding difficulties included optimizing the use of both public and private funding resources (Chausson et al., 2023). This will become even more pertinent in the current economic and geo-political situation, with dramatic cuts in international aid for conservation and research¹. In a time of financial uncertainty, and given the mixed social outcomes of conservation historically (West et al., 2006), caution must be taken so that NbS are real conservation actions with real societal benefits and not merely greenwashing (Gałęcka-Drozdka et al., 2021). This, as well as concerns around the legitimacy of growing carbon or biodiversity markets and the possibilities of land-grabbing (Larson et al., 2013) adds to the need to have a firm consensus on what does or does not constitute an NbS.

Integration or cultural adaptation is often cited as an obstacle for NbS. This can be found in diverse processes and approaches of NbS, from the abandonment of traditional land management systems, to the mobilization of actors. Modification of land practices can create changes in socio-cultural values and have an impact not only on the land (Cusens et al., 2024), but also on potential stakeholder participation. Identifying points of agreement and conflict is necessary for navigating differences in values for conservation planning for specific sites at a given time (Ernoul et al., 2021). This integration can be seen in several successful case studies including the coastal management in Sardinia, Italy or the Buno River in Albania. Both of these cases have integrated the NbS concepts into their local cultures, implicating diverse stakeholders and socio-economic stakes to address biodiversity conservation (IUCN, MedWet & Tour du Valat, 2020). The importance of effective communication and the identification of real benefits (economic and

socio-cultural) are also recommended as keys for improving acceptance and mobilization around NbS projects. NbS communication was highlighted and successfully put in place in Montenegro through the diffusion of scientific, ecological and economic information through different sectoral and cross-sectoral stakeholders from governmental to civil-society organizations (Popovicki et al., 2023). Cost benefit analysis is one potential tool (Bodin et al., 2022) that can be used both for communication and decision making to aid overcome some barriers. Its effectiveness is based on the extent to which the costs and the benefits speak to the local context, are transparently communicated with those on the receiving end of the costs/benefits, and integrate positive and negative impacts that are not necessarily quantifiable. Cost benefit analysis can draw attention to the need to strengthen socio-economic opportunities, increasing buy-in for local populations, and ensuring equitable tradeoffs between risk and benefits. Assessment and economic tools were also tested and evaluated in the scientific literature and promoted to reduce existing inequalities and uneven distribution of benefits (Barreca et al., 2024).

Technical difficulties often centered around assessing climate change impacts to develop adaptation measures, transforming research findings into concrete management propositions and technical capacities on the ground. As suggested by Kadykalo et al. (2021), it is essential to build bridges between the newest research and demonstration sites in the field. These bridges should link climate change scenarios to ecosystem functions and ecological restoration in order to find the best NbS alternatives for each site. Less than 30 % of the documents in our review had a multi-ecosystem approach, with the majority of documents targeting specific habitats or ecosystems. By focusing on certain ecosystems, it is difficult to have a landscape approach, minimizing effects of conservation on target species (Van Lanen et al., 2023) and the importance of interactions between ecosystems. Recommendations were made for NbS to favor a multi-ecosystem approach (Tomao et al., 2017), with a common vision that promotes connectivity between habitats and between marine/terrestrial systems. This landscape approach could embed NbS into large-scale networks (Eekhout et al., 2024; Guelmami, 2024), combining the planning and implementation of NbS in conjunction with conventional engineering works (Ibrić et al., 2024).

There were several subjects which were featured more strongly in the consortium documents than the academic documents, or vice versa. For instance, there was little research carried out on the main governance and funding difficulties highlighted in the consortium documents. Furthermore, except for a few guidance-oriented articles suggesting site identification, the academic research did not consistently respond to the identified difficulty of transforming research findings into concrete management propositions. This may be a continual challenge given the purpose of academic research, as compared to documents which describe frameworks and management plans; but it demonstrates that there is a missing function that can translate the findings from research into concrete actions. We noted that societal challenges identified by the IUCN – disaster risk reduction, economic and social development, food security and water security – were found in a small number of Web of Science results (with less than 10 results), suggesting an underrepresentation of these topics in academic NbS literature, or at least that the language used to speak about these challenges is inconsistent between research and institutional structures.

Lastly, the academic research also included more studies that elicited stakeholder and expert perceptions of NbS, bringing together analytical reflections on the concept, whereas the consortium documents were more concentrated on mobilising these stakeholders towards implementation. These gaps and differences in content reinforce the need to bridge the communication between practitioners and research, ensuring scientific rigor in promoting NbS which might entail additional testing and evaluation methods (Peñacoba-Antona et al., 2021).

The fact that the MBC partners favored guides and scientific articles over other types of documentation could also suggest one way forward to improve communication and dissemination (Sutherland et al., 2020)

¹ <https://www.devex.com/news/europe-is-cutting-development-spending-and-it-s-not-because-of-trump-109668>.

to best reach the target audience in a more efficient manner. When trying to improve communication and dissemination, it is important to stress the similarities between global and Mediterranean perspectives. This could be useful because it allows scientists, practitioners and civil society to benefit from a greater source of information and exchange experience outside of a specific region.

The concept of NbS remains at the forefront of conservation efforts not only in the Mediterranean region but around the world. The results of this literature review show how the concept has become an integral part of environmental discourses and has directed funding opportunities, training and project implementation. Although NbS do offer potential benefits to improve nature conservation, they are one of many possible strategies that can be used and NbS are not a guaranteed solution to resolve the current state of biodiversity. A combination of different concepts, integrating the individual contexts of each site is essential to move forward and advance nature conservation in the future.

5. Conclusion

Interdisciplinarity and participative practices are recommended to fill knowledge gaps and overcome the difficulties which practitioners experience in trying to achieve the intended outcomes of NbS projects. Systematic and political changes affecting every level and partner is implied by the variety of recommendations, making an enabling environment for NbS an ambitious endeavour.

One key recommendation from the literature was gaining stakeholder support. Linked to stakeholder support, public participation was considered as a necessary criterion for the success of NbS. Selecting and adapting NbS to specific social and ecological contexts, a balance of trade-offs and improvement of inequalities was highlighted as prerequisites by both data bases, and both highlight room for improvement with public communication regarding NbS.

What is notable is that even though *thematically*, there was a relative coherence between the MBC documents and the Web of Science documents, there was little overlap between the two databases. This may suggest three things. Firstly, that academic documents are just one of many types of material considered useful to practitioners. Secondly, that academic articles with a scope beyond the Mediterranean can still be useful for practitioners in the region. And thirdly, projects described explicitly as NbS do not reflect the extent of work which may be considered as NbS or which is informative to practitioners implementing NbS.

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CRedit authorship contribution statement

Lisa Ernoul: Writing – review & editing, Writing – original draft, Supervision, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Conceptualization. **Benjamin Hetherington:** Writing – original draft, Methodology, Investigation, Formal analysis, Data curation.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jnc.2025.127109>.

Data availability

We have included the data in the [supplementary material](#).

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