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Priority questions for biodiversity conservation in the Mediterranean biome: Heterogeneous perspectives across continents and stakeholders

Francisco Moreira[1,2,3] | Nicky Allsopp[4] | Karen J. Esler[5] | Grant Wardell-Johnson[6] | Leonardo Ancillotto[7] | Margarita Arianoutsou[8] | Jeffrey Clary[9] | Lluis Brotons[10,11,12] | Miguel Clavero[13] | Panayiotis G. Dimitrakopoulos[14] | Raquel Fagoaga[15] | Peggy Fiedler[16] | Ana F. Filipe[1,2] | Eliezer Frankenberg[17] | Milena Holmgren[15] | Pablo A. Marquet[18,19,20] | Maria J. Martinez-Harms[21] | Adriano Martinoli[22] | Ben P. Miller[23] | Linda Olsvig-Whittaker[24] | Patricio Pliscoff[25,20] | Phil Rundel[26] | Danilo Russo[7] | Jasper A. Slingsby[4,27] | John Thompson[28] | Angela Wardell-Johnson[29] | Pedro Beja[1,2]

[1]CIBIO/InBIO, University of Porto, Vairão, Portugal

[2]CIBIO/InBIO, Institute of Agronomy, University of Lisbon, Lisbon, Portugal

[3]Society for Conservation Biology, Europe Section, Washington DC

[4]South African Environmental Observation Network (SAEON) Fynbos Node, Claremont, South Africa

[5]Department of Conservation Ecology and Entomology, and Centre for Invasion Biology, Stellenbosch University, Stellenbosch, South Africa

[6]School of Molecular and Life Sciences, Curtin University, Perth, Western Australia, Australia

[7]Wildlife Research Unit, Dipartimento di Agraria, Università degli Studi di Napoli Federico II, Portici, Italy

[8]Department of Ecology and Systematics, Faculty of Biology, National and Kapodistrian University of Athens, Athens, Greece

[9]Natural Reserve System, University of California, Davis, California

[10]InForest Jru (CTFC-CREAF), Solsona, Spain

[11]CREAF, Cerdanyola del Vallés, Spain

[12]CSIC, Cerdanyola del Vallés, Spain

[13]Estación Biológica de Doñana-CSIC, Sevilla, Spain

[14]Biodiversity Conservation Laboratory, Department of Environment, University of the Aegean, Mytilene, Greece

[15]Resource Ecology Group, Wageningen University, Wageningen, The Netherlands

[16]Natural Reserve System, University of California Office of the President, Oakland, California

[17]National Natural History Collections, The Hebrew University of Jerusalem, Jerusalem, Israel

[18]Departamento de Ecología, Facultad de Ciencias Biológicas, Pontificia Universidade Católica de Chile, Santiago, Chile

[19]Instituto de Ecología y Biodiversidad (IEB), Laboratorio Internacional en cambio Global (LINCGlobal), Santiago, Chile

[20]Centro de Cambio Global UC, Pontificia Universidad Católica de Chile, Santiago, Chile

[21]Center for Applied Ecology and Sustainability (CAPES), Pontificia Universidad Catolica de Chile, Santiago, Chile

[22]Unità di Analisi e Gestione delle Risorse Ambientali, Guido Tosi Research Group, Dipartimento di Scienze Teoriche e Applicate, Universita' degli Studi dell'Insubria, Varese, Italy

[23]Kings Park Science, Department of Biodiversity, Conservation and Attractions, Perth, Western Australia, Australia

[24]German Protestant Institute of Archaeology in the Holy Land, Research Unit of the German Archaeological Institute, Auguste Victoria Compound, Jerusalem, Israel

[25]Departamento de Ecología, Instituto de Geografía, Santiago, Chile

[26]Department of Ecology and Evolutionary Biology, University of California (UCLA), Los Angeles, California

[27]Centre for Statistics in Ecology, Environment and Conservation, Department of Biological Sciences, University of Cape Town, Rondebosch, South Africa

[28]UMR 5175 CEFE, Montpellier, France

[29]Centre for Human Rights Education, Curtin University, Perth, Western Australia, Australia

Correspondence
Francisco Moreira, CIBIO—Instituto Superior de Agronomia, Universidade de Lisboa,Tapada da Ajuda, 1349-017 Lisbon, Portugal.
Email: fmoreira@cibio.up.pt

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Abstract

The identification of research questions with high relevance for biodiversity conservation is an important step towards designing more effective policies and management actions, and to better allocate funding among alternative conservation options. However, the identification of priority questions may be influenced by regional differences in biodiversity threats and social contexts, and to variations in the perceptions and interests of different stakeholders. Here we describe the results of a prioritization exercise involving six types of stakeholders from the Mediterranean biome, which includes several biodiversity hotspots spread across five regions of the planet (Europe, Africa, North and South America, and Australia). We found great heterogeneity across regions and stakeholder types in the priority topics identified and disagreement among the priorities of research scientists and other stakeholders. However, governance, climate change, and public participation issues were key topics in most regions. We conclude that the identification of research priorities should be targeted in a way that integrates the spectrum of stakeholder interests, potential funding sources and regional needs, and that further development of interdisciplinary studies is required. The key questions identified here provide a basis to identify priorities for research funding aligned with biodiversity conservation needs in this biome.

KEYWORDS
climate change, governance, policy, recommendations, research questions, stakeholder differences, threats

1 | INTRODUCTION

There is a large diversity of methods and approaches to improve environmental decision-making, including horizon scanning (Sutherland & Woodroof, 2009), expert elicitation (Hemming, Burgman, Hanea, McBride, & Wintle, 2018), scenario planning (Cook, Inayatullah, Burgman, Sutherland, & Wintle, 2014), or the identification of priority issues for conservation (Ockendon et al., 2018). In the context of biodiversity conservation, horizon scanning and the identification of priority policy-relevant research questions have been commonly used approaches (Kark et al., 2016). The seminal essay by Sutherland et al. (2009) was the first aiming at compiling a list of questions that, if answered, would have the greatest impact on the practice of conserving biological diversity worldwide. Other exercises using a similar approach have since then been developed, focusing on different aspects of biodiversity or natural resources (e.g., Fleishman et al., 2011; Rudd et al., 2011; Sutherland, Fleishman, Mascia, Pretty, & Rudd, 2011). Once identified, these questions are expected to become priorities for research funding and conservation investment (Kark et al., 2016; Sutherland et al., 2009).

The identification of specific questions or broader research topics perceived as of top importance for biodiversity conservation may be influenced by different drivers. Regional differences in the type and magnitude of biodiversity threats, socioeconomic and political contexts might affect the outcomes of a question prioritization exercise. In addition, the type of stakeholders involved in the consultation may affect the outcome, as scientists, practitioners, policy makers and other stakeholder types may have different views on priority topics for

biodiversity conservation (Kark et al., 2016). These views will be affected both by the perceived social values assigned to different topics and the real need for scientific information to tackle a given biodiversity threat. Therefore, an understanding of how stakeholder types and sectors of the society perceive research needs (Sutherland et al., 2011) is needed for science to be more embedded in society (Anonymous, 2017; Keeler et al., 2017), and this depends on inclusive consultation of different stakeholders (Cook et al., 2014; Tallis & Lubchenco, 2014).

The Mediterranean biome includes several biodiversity hotspots (Myers, Mittermeier, Mittermeier, Fonseca, & Kent, 2000) that are particularly sensitive to different drivers of biodiversity loss (Esler, Jacobsen, & Pratt, 2018; Sala et al., 2000). Although the biome occurs in five distinct regions of the planet (Mediterranean basin, United States (a residual area in Mexico), Chile, Australia, and South Africa), these share common climate, biodiversity features (e.g., levels of plant richness and diversity), and drivers of biodiversity loss, leading to a long history of comparative research (Esler et al., 2018) and biome-level approaches to conservation (Brooks et al., 2006; Cox & Underwood, 2011; Underwood et al., 2009; Underwood, Viers, Klausmeyer, Cox, & Shaw, 2009). In spite of this, the five Mediterranean regions have different historical, cultural, social and political contexts and dynamics (Esler et al., 2018), and experience differences in the magnitude and type of threats to biodiversity (Underwood, Viers, et al., 2009). Therefore, topics identified as more important for biodiversity conservation may differ among the five regions as well as between stakeholder types. To quantify and understand such differences, we undertook a Mediterranean-biome wide survey of six different types of stakeholders (respondents from research institutions, governmental agencies, NGOs, land managers, environmental consultancies, and business corporations) from the five terrestrial Mediterranean-climate regions of the world. We aimed to: (a) identify the more important topics for biodiversity conservation in this biome, (b) evaluate the relative importance of stakeholder type and region in topic prevalence, and (c) identify the more important specific research questions within each topic. We found different perceptions on priority topics across regions and stakeholder types, and we have identified the more relevant questions within each topic based on their prevalence across regions and stakeholders.

2 | METHODS

2.1 | Setting the geographic scope

This initiative focused on the areas included in the five terrestrial Mediterranean-type regions of the world, including freshwater and transitional (i.e., estuaries, coastal lagoons) ecosystems but excluding the marine realm. Because the exact limits of such regions vary widely across authors (Esler et al., 2018; Klausmeyer & Shaw, 2009), we used the relatively conservative delimitation provided by the WWF Ecoregions project (Olson et al., 2001) and considered the areas corresponding to the Mediterranean Forests, Woodlands, and Scrub biome (biome code =12).

2.2 | Organization of the core team and procedure for gathering questions

This initiative was organized jointly by the Society for Conservation Biology—Europe Section, a network of professionals working on the conservation of biodiversity with a special interest in European issues, and the International Society of Mediterranean Ecologists—ISOMED, an international professional society established to promote research, conservation, and public awareness of the biological diversity of the world's Mediterranean-climate regions.

The initial stage was to establish a group of at least one to three coordinating researchers per country in the five Mediterranean regions of the world, who would organize an inquiry among different stakeholder types. For the large and multi-state Mediterranean Basin region, we tried to include scientists for each of the main Mediterranean countries in Europe, the Middle-East, and North Africa (Portugal, Spain, France, Italy, Greece, Israel, Turkey, Tunisia, Algeria, and Morocco), but only successfully recruited investigators for the first six countries, covering most of the northern shore of the Mediterranean Basin.

The coordinators for each country aimed at obtaining a sample of at least 10 individuals associated with each of the six different types of stakeholders covering a broad range of areas of activity and expertise (see Section 2.3). Based on a prioritization approach develop at the world scale (Sutherland et al., 2009), we asked stakeholders to identify questions whose answers would imply a high probability of increasing the effectiveness of conservation of biological diversity in their Mediterranean region. Responses were anonymous although respondents could provide an organizational affiliation or name. We also asked respondents to formulate questions in their own language (English, French, Italian, Spanish, Portuguese, and Greek), rather than using English. This approach was taken to have a more inclusive set of respondents, rather than a sample biased against people with low or no proficiency in English. Participants were asked to express their own views, and not necessarily those of the institution to which they were affiliated. By focusing on individuals rather than on organizations, we aimed to reduce any pressure to formulate "politically correct" questions and avoid "institutional" positions.

Approaches to solicit replies varied across countries and included e-mail, letters, meetings, workshops, direct

interviews, and internet-based inquiries. Independently of the used approach, the scope of the initiative and its aims were described, so that each respondent was fully aware that the objective was to identify questions that if answered, would have a high probability of increasing the success of actions targeted at the conservation of biological diversity in the Mediterranean region where they worked (Sutherland et al., 2009). The whole initiative started in June 2014 and questions were gathered during March to September 2015.

2.3 | Topics and stakeholder types

Each individual surveyed was asked to formulate up to 10 questions allocated to any of 11 predefined topics (see SI 1 in Supporting Information S3 for more details): climate change; species management; habitat management and restoration; non-native species; ecosystem functions and services; protected areas; farming and forestry; fire and grazing; impact assessment and mitigation; governance; public participation and perception. There was some unavoidable overlap among topics, but this was minimized as much as possible by providing respondents with a clear definition of the main issues associated with each topic. Definition of topics was inspired on a previous global exercise (Sutherland et al., 2009) where these have been set a posteriori, but the created categories were adapted to the Mediterranean context. In our case, this a priori definition aimed to help guide stakeholder preference selection among a set of possible alternatives that would facilitate comparisons, but respondents were also allowed to allocate questions to an "other topics" open category, if they considered their questions did not match the range of a priori themes. Inquiries and replies were made in the native language of each country rather than in English, because the later could introduce biases linked to variation in English proficiency across stakeholders. We aimed to include a broad range of stakeholders, inviting responses from individuals within the following six sectors considered relevant for biodiversity conservation in the Mediterranean biome: (a) national, subnational and regional public departments responsible for biodiversity conservation (e.g., government bodies and ministries; regional and national agencies responsible for nature conservation; natural park services and similar), (b) environmental non-governmental organizations (NGOs) related to biodiversity conservation, (c) organizations and individuals linked to land management (e.g., farmers, forest managers and hunters associations), (d) research organizations (universities and research centers), (e) Environmental consultants (e.g., companies or freelance professionals related to environmental impact assessment and land use planning), (f) Business corporations, mainly the ones with significant impacts on the environment (e.g., energy production and transport, mining, cement industry, road and railway, tourism, food production, forest products).

2.4 | Data gathering and post-processing

In a first stage, all questions from a given country were translated to English by a local researcher, and double-checked if needed with a native English speaker. Then, we discarded questions that were out of scope (e.g., marine issues) or unintelligible, and questions too general to be of interest for our exercise (e.g., "what is the impact of climate change on biodiversity"). Subsequently, we split questions that were actually composed of several sub-questions. All questions related to a given topic were gathered in a separate file.

We initially sought to use the Sutherland et al. (2009) criteria as a starting reference for defining question eligibility, including, among others, being answerable through a realistic research design, addressing a gap in knowledge, and not being formulated as a general topic area. However, we had a much wider range of stakeholders compared with this previous initiative, which was targeted to conservation organizations, professional scientific societies, and universities. If these strict criteria were followed, we would, to a large extent, end up with questions put forward by researchers, which would bias the exercise against stakeholders with more difficulty in formulating precise research questions. We had, therefore, to be less restrictive when deciding on question eligibility and accepted more general questions.

In a second stage, each of the original (including split) questions was screened again and, if justified, reclassified to a more appropriate topic (e.g., questions on interactions between climate change and other factors were all assigned to the former topic). Questions with mentions to specific taxa (e.g., questions on specific species of conservation value, or invasive non-native species exclusive to a specific Mediterranean region) were rephrased for generalization so that the resulting question could be applicable to any region. Finally, questions with different formulation but addressing the same issue within each topic were pooled in a single common question. This procedure was carried out for all questions within each of the 11 topics by one or jointly by two authors, to assure consistency in the approach used.

2.5 | Data analysis

The relative proportion of questions related to different topics, overall and across regions/stakeholder types, was used to indicate "hot topics" of higher importance (Braunisch, Home, Pellet, & Arlettaz, 2012). Differences in frequencies of occurrence across stakeholder types and regions were tested using G-tests of independence with Williams correction (Signorell et al. 2019). Post-hoc pairwise

comparisons were performed using the Bonferroni correction (Hervé 2018).

The potential influence of region and stakeholder type on the likelihood that a question was related to a given topic was assessed using generalized linear mixed models. This was performed separately for each topic, by creating a binary variable expressing whether the question was related or not to the topic and considering region and stakeholder as categorical variables. Models were fitted with package "lmer4" (Bates, Mächler, Bolker, & Walker, 2014), setting a binomial distribution and a logit link function, with region and stakeholder as fixed effects, and inquiry ID as a random effect. Model building started with both region and stakeholder, followed by backward elimination using the drop1 function (applying likelihood ratio chi-square tests). All analyses were performed using R for Windows (R Core Team 2016). Data are available as a CSV file in the Supporting Information S1–S3.

Previous similar initiatives often used final workshops with subgroups and consensus-based discussions to identify the more important questions within topics (Sutherland et al., 2011). In our case, this would have been hard to achieve given the logistic constraints caused by the wide diversity of regions and stakeholders included. We therefore opted to assess the relative importance of each question based on an index estimated from the product of three normalized parameters: (a) the number of Mediterranean regions (1–5) where each question was formulated, normalized by dividing by its potential maximum value (5), (b) the number of different stakeholder types (1–6) addressing the question, normalized by dividing by its potential maximum value (6), (c) the total number of times the question was raised, normalized by dividing by the frequency of the question raised more often in that specific topic. This process weighted each parameter equally to give a score that ranged from higher than 0–1, with the maximum value corresponding to a question that was raised in all Mediterranean regions, by all stakeholder types, and was the most frequently formulated question for that topic.

3 | RESULTS

3.1 | Region and stakeholder type feedback

A total of 205 responses were received (92 from the Mediterranean basin countries, 53 from South Africa, 25 from Chile, 20 from Australia, 15 from California) corresponding to an initial set of 1,613 questions. After discarding questions out of scope, unintelligible, or too general, we ended up with 1,490 questions that were the focus of our analyses. Although up to 10 questions were sought per respondent, the number of responses was more variable (median = seven questions per respondent; range = 1–29 after question splitting). These came mostly from the Mediterranean basin (703 questions), where a higher effort was done (six countries involved), followed by South Africa (315), Chile (268), Australia (147), and the United States (57). As for stakeholder type, most questions came from research institutions (536), followed by governmental agencies (398), NGO (199), consultants (198), business corporations (72), and land managers (71). For 16 questions, there was no information on stakeholder type due to mislabeling. In all regions, respondents from research and government agencies provided the highest number of questions (SI 2 in Supporting Information S3). However, the frequency of stakeholder type respondents was not independent from region (G-test =115.6, df = 20, $p < .001$), with pair-wise tests showing similar patterns across regions for government, NGOs and researcher respondents, but significant differences ($p < .05$) for the other stakeholder pairs (exception for the pair NGO-Consultants, $p = .059$), most noticeably in the case of land managers and respondents linked to business (both different from all other types).

3.2 | Overall importance of topics and general patterns across regions and stakeholder types

Overall, questions were not uniformly distributed across topics ($\chi^2 = 141.7$, df = 10, $p < .001$), with Governance being predominant (15.6% of the questions), followed by Climate Change, Species management, Public participation, and Habitat management (respectively 11.8, 10.7, 10.3, and 10.2%) (SI 3 in Supporting Information S3). Fire and Grazing was the least represented topic (6.0% of the questions). Despite the overall trends mentioned above, the prevalence of questions related to different topics varied substantially across region (SI 4 in Supporting Information S3 and Figure 1). For example, climate change questions had highest prevalence in the United States and Australia, while Species management, Farming and forestry, and Impact assessment were more important in the Mediterranean basin. Likewise, topic prevalence was varied between stakeholder types (SI 5 in Supporting Information S3 and Figure 1). For example, impact assessment questions were raised mainly by respondents from business corporations, whereas questions related to Climate change were more prevalent in researchers' responses. As a result, the range of ranked importance for each topic was quite variable across regions and stakeholders (Figure 2). As an example, governance was the topic with higher number of questions in the majority of the regions (median rank was first), but it ranked 6th in one of them. This variability was much lower in terms of stakeholder preferences, where the number of questions related to governance ranked first or second across all stakeholder types.

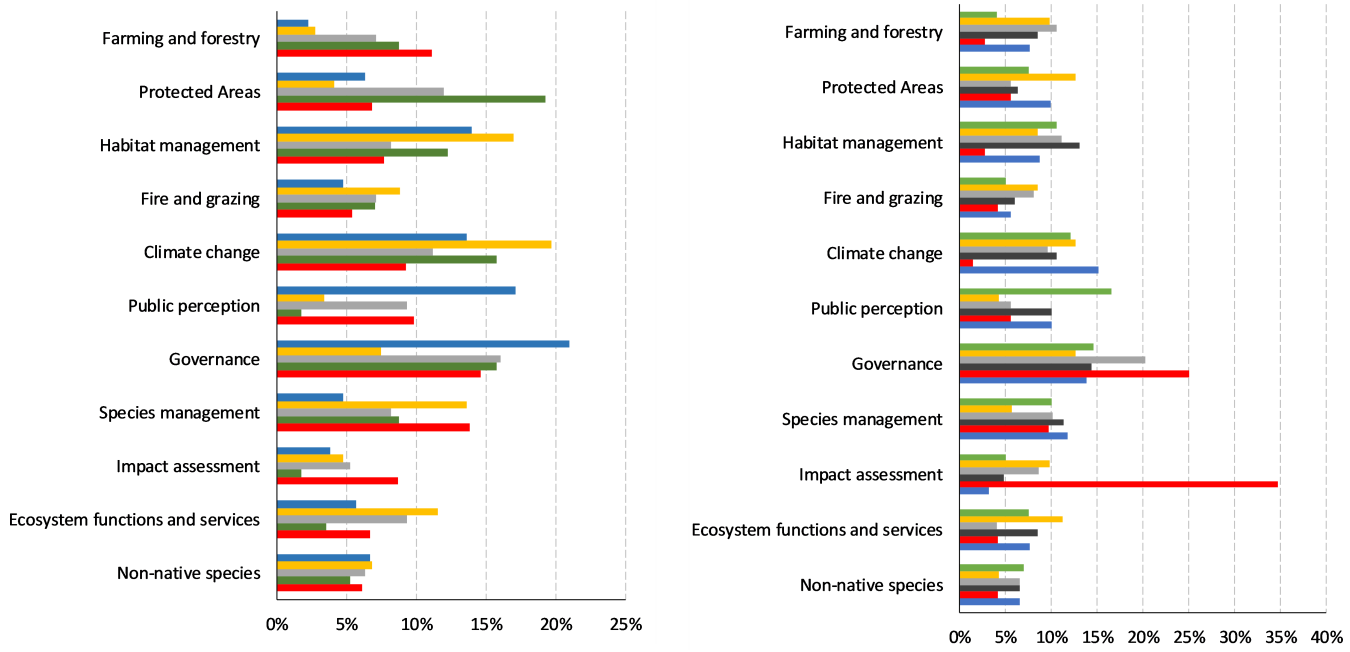

FIGURE 1 Percentage of questions in different topics across regions (left) and stakeholder types (right). Values sum to unity across regions and stakeholders. Color codes for regions (N = number of respondents by region): Mediterranean basin (red; $N = 703$), United States (green; $N = 57$), Chile (gray; $N = 315$), Australia (yellow; $N = 147$), South Africa (blue; $N = 315$). Color codes for stakeholder types: (N = number of respondents by type): Researchers (blue; $N = 536$), business corporations (red; $N = 72$), governmental agencies (black; $N = 398$), consultants (gray; $N = 198$), land managers (yellow; $N = 71$), NGO (green; $N = 199$)

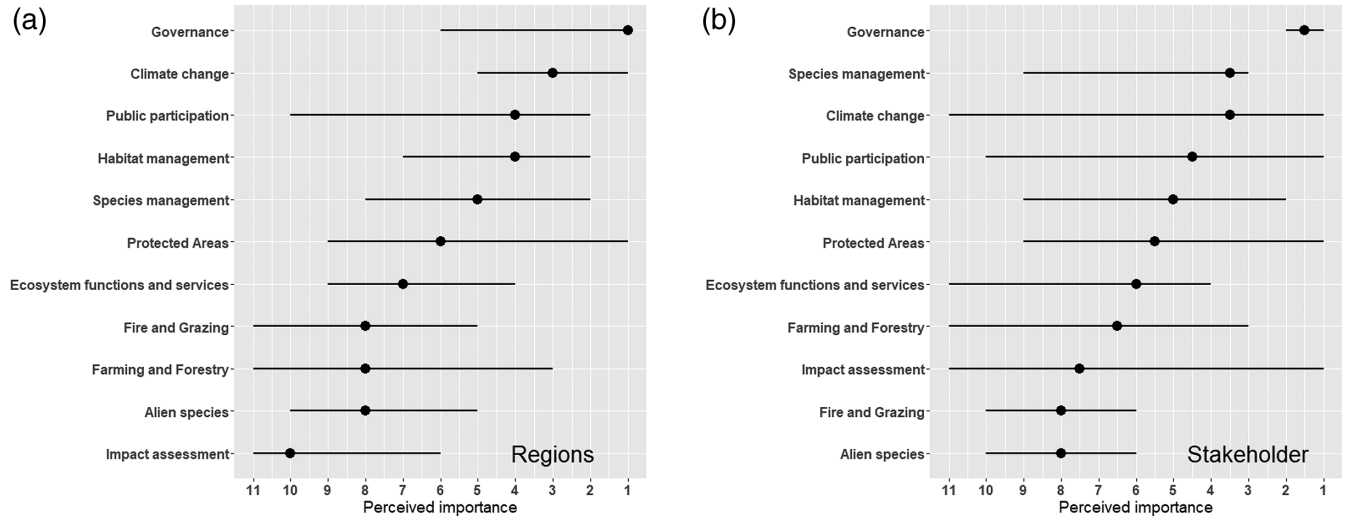

FIGURE 2 Median (dot) and range (whiskers) of the ranked perceived importance of 11 research topics with relevance for biodiversity conservation (based on the number of initial questions within each topic; top importance = 1, least importance = 11) across the five Mediterranean-type regions of the world (left) and across the six stakeholder types (right). Topics are ordered by decreasing median rank

3.3 | The relative importance of region and stakeholder type

For most topics, the likelihood of a question being related to that topic was affected by both region and stakeholder type (SI 6 in Supporting Information S3). In particular: (a) the probability of a question being related to Ecosystem function and services, non-native species, Fire and Grazing, and Governance, did not vary across regions or stakeholders; (b) the likelihood of selecting a question related to Impact Assessment or Climate change was associated with stakeholder type, with the former topic being more likely if the respondent came from Business or Consulting companies, and the latter being less likely if the respondent came from Business; (c) the probability of a

question being related to five of the topics was influenced by region: Farming and Forestry questions were less likely in South Africa and Australia, whereas questions related to habitat management and restoration were more likely in these regions; questions related to Protected Areas were more likely in Chile and the United States; questions focused on species management were less likely in South Africa; questions on public participation were less likely in Australia.

3.4 | Priority research questions within topics

The initial 1,490 questions were combined and merged into a final 171 distinct questions. The ratio of initial to merged questions was variable across topic (mean = 9.3, median = 8.4, range = 4.5–21.1, n = 11), expressing different levels of merging. Excel files including summaries of rephrased questions for each of the topics are shown in SI. Detailed lists of the four questions with higher importance within each topic (based on the estimated index) are shown in SI 7 in Supporting Information S3.

4 | DISCUSSION

4.1 | Key questions for biodiversity conservation in the Mediterranean biome

Considering their rank in terms of proportion of total questions across regions and stakeholder types, governance and climate change appeared as top issues. Governance is of key importance probably because important biodiversity features often co-exist with human activities both inside and outside protected areas in many Mediterranean regions (Cox & Underwood, 2011). For example, within Mediterranean Europe, there is a large amount of farmland outside protected areas that is considered of high natural value (Lomba et al., 2014). Additionally, because of a weak development of integrative approaches to policy making and evaluation of policy outcomes (Jordan & Lenschow, 2010), it is crucial to assess what, when and how management actions, stakeholder involvement and policy decisions are effective in biodiversity conservation. In parallel, compared to other biomes in the world, biodiversity of Mediterranean regions is particularly prone to impacts from global, including climate, change (Malcolm, Liu, Neilson, Hansen, & Hannah, 2006; Sala et al., 2000). Assuming a priority ranking based on the estimated index of question prevalence across regions and stakeholders, the key issues identified within each of these and the other topics are summarized in Table 1.

4.2 | Differences across regions and stakeholders

Differences among regions possibly arise from their specificities. For example, in the Mediterranean Basin, a much longer history of occupation by agrarian societies (compared to the other regions) has been associated with the development and spread of agricultural systems with high cultural and biodiversity values (Esler et al., 2018). Hence, biodiversity conservation in farmland is an important issue, for example, the impacts of agricultural policies (Pe'er et al., 2014). This contrasts with Australia and South Africa, where, as a result of native habitat loss to intensive agriculture and forestry, biodiversity values in the agricultural/forestry matrix remain confined to small patches of remnants of natural vegetation (e.g., Esler et al., 2018). In these latter regions, most questions relate to habitat or species conservation in protected areas, rather than to forest or farmland management. Habitat management and restoration were perceived as more important in Australia and South Africa, maybe as result of marked investments in industrial-scale rehabilitation linked to mining (Australia) and improving degraded areas in mountain catchments (South Africa) (Esler et al., 2018). The fact that species management questions were less common in South Africa may reflect the existence of a whole-biome (fynbos) conservation approach dating back for some time (van Wilgen et al., 2016). Higher emphasis on protected areas was placed in regions that hold the highest (California; ca. 20%) and lowest (Chile; ca. 1%) proportions of nature reserves in their Mediterranean territory (Cox & Underwood, 2011; Pliscoff & Fuentes-Castillo, 2011).

Additionally, differences across stakeholder types possibly reflect sectorial priorities. Businesses and consultants showed much higher interest in impact assessment, likely because environmental impact assessments represent a key tool to avoid, reduce and compensate for the negative impact of human activities on the environment, with direct consequences for businesses in terms of licensing, need for compliance with law (Lion, Donovan, & Bedggood, 2013) and costs. In contrast, although climate change represents a risk for the business sector (Kim & Lee, 2016), the impacts of climate change on biodiversity were of secondary interest for this group of stakeholders, whereas it was the most important topic for researchers, reflecting an already acknowledged priority bias among conservation scientists (Titeux, Henle, Mihoub, & Brotons, 2016) and/or a potentially lack of interest from other stakeholder types, more focused on their activity-specific issues.

4.3 | Study limitations

As with previous similar approaches, there are a number of limitations in the adopted approach. First, the a priori identification of topics in which to frame questions, which was

TABLE 1 List of more important issues for research applied to biodiversity conservation in the Mediterranean biome, for each of the 11 considered topics. See the SI for a detailed list of questions

Governance: • Effectiveness of legislation and policy • Communicating the evidence base • Promoting conservation behavior • Effectiveness of governance structures	Climate change: • Identifying the more susceptible species and habitats • Impacts on biodiversity drivers • Changes in distribution patterns • Impacts on physiology and demography	Public participation: • How to communicate the importance of biodiversity • Increasing public participation in biodiversity management • Drivers of human attitudes and behavior • Accommodating different views and value systems
Habitat management: • Best techniques for restoration • Tools to evaluate conservation and restoration effectiveness • Setting conservation and restoration priorities • Restoring aquatic habitats	Species management: • Optimize monitoring • Identify key drivers of population trends • Trade-offs and multiple goals for conservation optimization • Use of restocking, translocations and reintroductions	Protected areas • Setting networks to maximize biodiversity coverage • Effectiveness of the current network of protected areas • Are biodiversity and ecosystem processes maintained • Improve conservation management
Ecosystem services: • Use of ecosystem services approaches to biodiversity conservation • Functions and services provided by key habitats and keystone species • Methods and tools for evaluation and monitoring • Using ecosystem services for better management decisions	Fire and grazing: • Prescribed fire and grazing as tools for biodiversity • Biodiversity impacts of changed fire regimes • Identify ecosystems and species more sensitive to fire and grazing regime changes • Interactions between fire and grazing	Farming and forestry: • Biodiversity conservation in intensive farming • Managing forest plantations • Impacts of farming on soil biodiversity • Importance of traditional management practices in agriculture and forestry
Non-native species: • Best techniques for control • Impacts on native biodiversity • Identifying priority non-native species for monitoring and control • Identifying emerging invasive species	Impact assessment: • Effects of soil and ground water impacting activities • Improve prediction of impacts in EIA studies • Effectiveness of biodiversity offsets • Impacts of anthropogenic linear infrastructures	

not done in previous similar exercises, could have biased stakeholder replies, although this decision aimed to guide stakeholder alternatives along a common set of topics, allowing an easier comparison of patterns across regions. Second, the post-processing of questions, including splitting, merging and assigning to topics also has inherent subjectivity. Finally, allowing more general questions contrasted with recommendations to focus on questions leading to realistic research projects (Sutherland et al., 2011). However, it did allow the identification of broad topics perceived as priority across stakeholder types. This identification should therefore be considered as part of a scoping process where key issues are identified first (Cook et al., 2014), and could be followed by question selection and refinement towards realistic research designs (Hemming et al., 2018; Sutherland et al., 2011). Overall, our results confirm that results of priority-setting exercises will be dependent on the set of participating stakeholders (Sutherland et al., 2011).

4.4 | Conclusions

Our results showed that identifying priority questions for biodiversity conservation within the Mediterranean biome, spread across five regions of the world, requires taking regional and stakeholder particularities into account (Peuhkuri & Jokinen, 1999). Therefore, a single one-size-fits-all list of questions does not appear to be the best solution. We also found that some identified questions have already been answered by scientific research, which suggest that existing evidence is not sought or used (Sutherland & Wordley, 2017), and demonstrating the need for more investment in

knowledge transfer to relevant stakeholders to narrow the science–policy gap (Bradshaw & Borchers, 2000).

Based on our findings, we recommend that the following aspects be considered when deciding priorities for biodiversity conservation research investment:

1. Matching research priorities to stakeholder interests and regional needs might potentiate the use of available regional or stakeholder funding for research. Research on specific questions might be funded through funding available for specific regions (even within countries), or supported by stakeholders (e.g., business companies) with interest in a particular topic. In fact, funding availability, or an economic analysis of the trade-offs that are involved in resource allocation decisions (Alston, Norton, & Pardey, 1995), could be incorporated in the process of research question selection. This would allow for available funding to be more effectively used, societal needs to be more effectively considered and for scientific evidence to be better integrated into regional and local policy processes and conservation actions (Turner et al., 2016; Weeks & Adams, 2017).
2. As previously acknowledged (e.g., Sutherland et al., 2011), if priority topics (and specific questions within these topics) are to be decided by top-down processes, then one should aim for inclusion of different stakeholder types in decision-making. This collaborative exercise may include the co-design of research questions and search for adequate funding sources that depend on stakeholder priorities. In this way the observed disagreement between priorities of research scientists and other stakeholders, previously identified in other contexts (Arlettaz et al., 2010; Rose et al., 2018) can be avoided, and societal needs taken into account. Using value of information approaches (Nicol, Ward, Stratford, Joehnk, & Chadès, 2018; Runge, Converse, & Lyons, 2011) might be used to help deciding on priorities, particularly to disentangle the relative importance of social values given by stakeholders to different topics and the real lack of scientific knowledge on those topics. Our study could not distinguish the influence of these two factors.
3. Governance and public participation issues are key to most regions, which highlights the importance of interdisciplinary studies with a strong participation of social scientists (Bennett et al., 2017; Braunisch et al., 2012). This also emphasizes the importance of the human and social dimensions of biodiversity conservation (Bennett et al., 2017; Peuhkuri & Jokinen, 1999) and is particularly important within a biome occurring across five regions with different governance, political and social backgrounds. This variability has been previously identified as an important driver of differences across regions (Rudd et al., 2011) and is a key issue to define the best regional/country-level strategies for biodiversity conservation targets. A focus on governance will also contribute to mainstreaming biodiversity concerns into other sectoral policies, for example, agricultural or energy policies (Redford et al., 2015).

We believe that by considering these recommendations, attempts to identify research priorities for biodiversity conservation will produce a closer alignment with regional and societal needs and be less subject to arbitrary influences from special interest groups.

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CONFLICT OF INTEREST

The authors declare no potential conflict of interest.

AUTHOR CONTRIBUTIONS

F.M. and P.B. conceived the idea; all authors carried out inquiries and post-processing of questions in their countries; F.M. carried out data analysis; all authors contributed to the interpretation of the results and to the final drafting of the manuscript.

DATA ACCESSIBILITY STATEMENT

All data that support the findings of this study are included in the Supporting Information S1–S3.

ORCID


Francisco Moreira https://orcid.org/0000-0003-4393-8018

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.

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