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Policy analysis

Conservation biology research priorities for 2050: A Central-Eastern European perspective

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ABSTRACT

One of the main goals of the EU Biodiversity Strategy for 2030 is to avoid further loss of biodiversity and to restore ecosystems. These efforts can be facilitated by compiling the main research topics related to conservation biology to provide new evidence for the most urgent knowledge gaps, and publicise it to researchers, research funders and policy makers. We used the possible future statements from the Hungarian Environmental Foresight Report for 2050 which identified region-specific problems. To highlight likely future environmental and conservation questions, in this study we asked researchers from the fields of ecology and conservation to define research questions addressing these future statements in line with international research trends and challenges. The study resulted in fourteen priority research topics, split into seven clusters relevant to biological conservation that should be targeted by stakeholders, primarily policy makers and funders to focus research capacity to these topics. The main overarching themes identified here include a wide range of approaches and solutions such as innovative technologies, involvement of local stakeholders and citizen scientists, legislation, and issues related to human health. These indicate that solutions to conservation challenges require a multidisciplinary approach in design and a multi-actor approach in implementation. Although the identified research priorities were listed for Hungary, they are in line with European

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and global biodiversity strategies, and can be tailored to suit other Central and Eastern European countries as well. We believe that our prioritisation can help science–policy discussion, and will eventually contribute to healthy and well-functioning ecosystems.

1. Introduction

Natural, semi-natural and appropriately managed ecosystems contribute to the health and well-being of people (IPBES, 2019), secure a sustainable provision of ecosystem services for future generations and support climate change mitigation and adaptation (Kotiaho et al., 2016; Navarro et al., 2017). At the same time, most human activities seriously undermine the integrity, functioning and services of ecosystems and threaten their health and stability by transforming them into species-poor, simplified or novel ecosystems (Coiffait-Gombault et al., 2012; Díaz et al., 2019). The maintenance of ecosystems' contributions to human well-being thus requires protection, management and restoration efforts. To that end, new conservation goals and targets have been adopted recently for the next decade (UN Decade on Ecosystem Restoration 2021–2030: UNEP/FAO, 2020; COM, 2019; GBO5, 2020). For example, the European Green Deal and the EU Biodiversity Strategy for 2030 both emphasise that beyond the conservation of vulnerable habitats, it is also fundamental to avoid further loss of biodiversity and to restore ecosystems in the future. For effective conservation it is also essential to bring together the policy makers, researchers and society on national as well as international levels. All sectors have to collaborate to support the restoration of habitats that contribute to the regeneration of ecosystems, restoring their natural functions (Dey et al., 2020).

The collection of the main research topics related to conservation biology and sustainable land use can facilitate conservation as well as restoration targets. Prioritisation of ecological knowledge gaps is important in designing ecological frameworks and projects for securing future ecosystem health and stability (Tolvanen and Aronson, 2016). Thus, effective conservation of biodiversity has to rely on evidence-based knowledge. Due to limited capacity and financial resources, expanding knowledge needs a prioritised list of research questions, to provide new evidence for the most urgent knowledge gaps. Collaborative research prioritisation studies in ecology have become popular in the last decade (Dey et al., 2020). A recent review and meta-analysis found that such studies in the fields of ecology, biodiversity conservation and environmental science have identified over 2000 research priorities between 2006 and 2020, but there are still important issues that have not yet been addressed (Dey et al., 2020). One reason for this surge of interest is that research prioritisation studies can help identify barriers to effective conservation science and practice and thus achieve conservation objectives (Fisher et al., 2019). Many collaborative research prioritisation studies are thematically similar (Dey et al., 2020), but vary either in regional focus: e.g. studies focusing on UK (Sutherland et al., 2006), USA (Fleishman et al., 2011), Hungary (Mihók et al., 2015), Oceania's small-island developing states (Weeks and Adams, 2018), Estonia (Lõhmus et al., 2019), Southeast Asia (Coleman et al., 2019), or in objective: e.g. on the Belt and Road Initiative (Hughes et al., 2020). Many studies exist where a group of experts identified and prioritised the main questions in the field of conservation biology as well as terrestrial and marine restoration ecology (see Ockendon et al., 2018; Lõhmus et al., 2019; Trevathan-Tackett et al., 2019; Sutherland et al., 2021). Some authors have already highlighted the priorities in global environmental aspects related to climate change, plastic pollution or declining global biodiversity (e.g. the study of Rudd et al., 2018; Provencher et al., 2020; Williams et al., 2020; Sutherland et al., 2021). Related to the ongoing technological revolution, new horizon scan (HS) studies investigate the future impacts of robotics, artificial intelligence and autonomous systems on urban biodiversity and ecosystems (Goddard et al., 2021). All these examples indicate that the identification of research priorities or knowledge gaps and questions provides guidelines for policy development and application, but they must be operationalised at the level of decisions, which is usually at the state level, or below. Since the development and enforcement of policies besides EU policy instruments mostly take place at the level of national institutions, the most effective way to utilise the results of research prioritisation studies is to inform national authorities such as ministries or agencies and research funding bodies (Dey et al., 2020).

Although the Central and Eastern European region (CEE) differs from economically well-developed countries in Western Europe (WE), European biodiversity policy needs to be relevant for all the different political and biogeographical regions of Europe. Hungary's status as a post-socialist CEE country considerably determines its environmental policy (Báldi and Batáry, 2011a, 2011b; Tryjanowski et al., 2011). Specifically, all territory of Hungary is part of the Pannonian Region (EEA, 2002a). Designated areas of the region within EU member states are included in the EU Natura 2000 network of protected areas (EC, 1992), and harbor a high diversity of habitats and species and a large number of endemic plants and animals, despite the fact that more than 60% of the region has been converted to agricultural land (EC, 2009). Since 70% of the Pannonian Region belongs to Hungary (EEA, 2002b), the country has a major role and responsibility in conserving its natural values, including biodiversity. In our study we addressed the future conservation priorities of the Pannonian biogeographical region from a CEE point of view. The conservation issues of Hungary well exemplify the problems of other post-socialist countries in CEE. Contrary to previous prioritisation studies, we did not simply ask experts to provide their opinions on knowledge gaps. Instead, we used possible future statements from the Environmental Foresight – Hungary 2050 report (Hideg et al., 2019) to highlight likely future environmental and conservation problems and ask the experts to define research questions addressing these future statements.

Here we aimed (i) to harmonise research priorities with a previous assessment of environmental horizon scanning produced by experts from a wide range of disciplines, (ii) to identify research topics in the field of conservation biology that are relevant to filling the most important knowledge gaps, (iii) to group the topics into clusters of research areas that can serve as inputs to research funding agencies for developing programs and grant calls to enhance the relevance of research in current and future conservation biology, and (iv) to investigate the political context of conservation issues in implementation. We believe that our prioritisation can help the science–policy discussion, and in the long run will eventually contribute to healthy and well-functioning ecosystems.

2. Materials and methods

The main knowledge gaps in conservation biology were identified, and research topics were prioritised using expert knowledge in five stages (Fig. 1). In the first stage an environmental HS exercise was applied with the participation of several experts from a wide range of disciplines (Hideg et al., 2019). The future statements for 2050 used as a starting point were formulated in a HS process. It is true that there is no one-size-fits-all HS methodology for all research needs, as the method is still under development (Hideg et al., 2021). HS is not a systematic process and involves a large set of information that is not easily handled by a research team (Schoemaker et al., 2013). Biases involved in HS may be an inaccurate or unjustified interpretation of future information (Schultz, 2006), and the subjectivity of experts, although intuitive logic can probably diminish the biases (Wright and Cairns, 2011). One of the aims of the current HS process was to systematically moderate the high subjectivity of the methodology and participants' evaluation (Hideg et al., 2021).

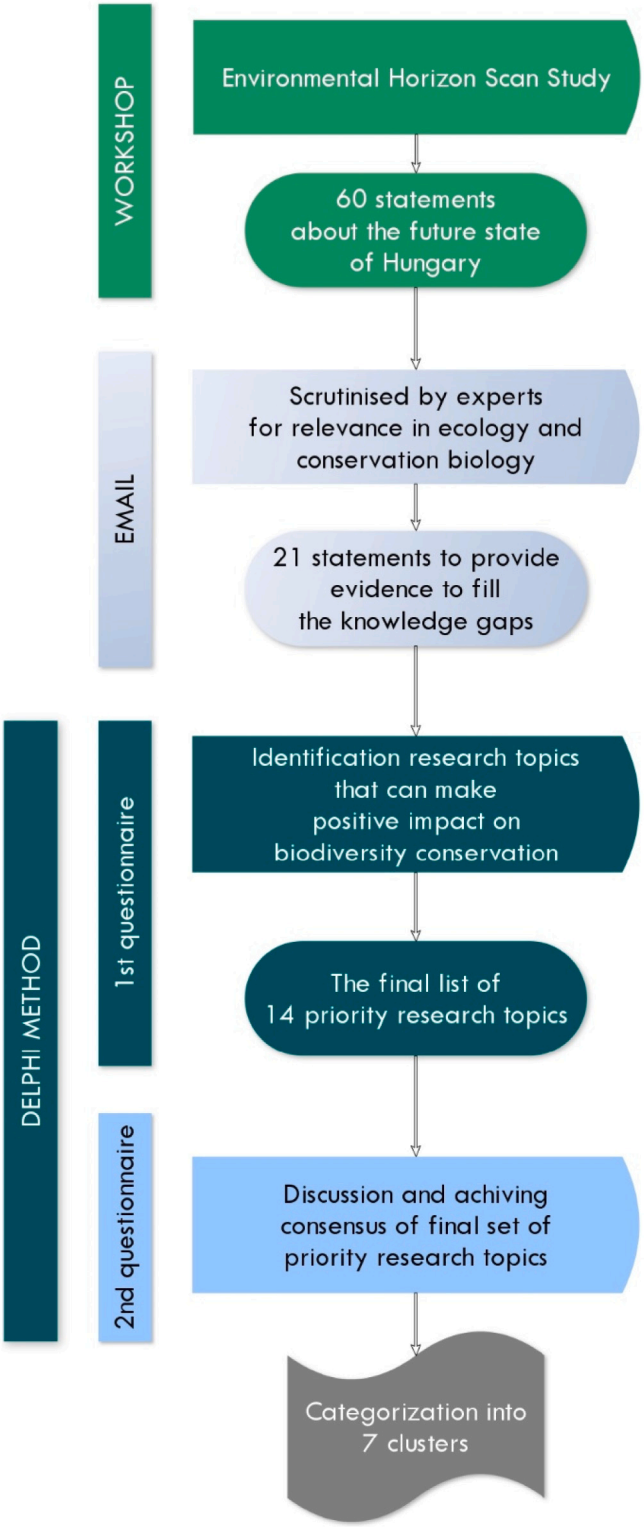

Fig. 1. The five stages used to identify and prioritise research topics relating to biodiversity conservation and society.

Our exercise targeted the study of possible trajectories along which Hungarian natural and social systems may change until 2050, considering their international relevance as well (Hideg et al., 2019, 2021). The HS study resulted in three themes and 60 statements about the possible future status of Hungary and how these scenarios might affect biodiversity: I. Technology development and its social and energy concerns in relation to waste production and usage (e.g. The climate change and lack of nature can generate new health care challenges, therefore, we will have to face new diseases and epidemics, and their treatment will also have to be solved.); II. Relationships between ecosystems, climate change and their social embeddedness (e.g. The role of restoration ecology will be more and more important in the improvement of domestic natural environment.); III. Interconnections between society, economy, science, higher education and security (e.g. Science will be based on big data and become interdisciplinary. The domestic science will not get enough money and only its practical benefit will be important, therefore it will have but local significance.) (Hideg et al., 2021; Table A1).

In the second stage, the 60 future statements from Hideg et al. (2019) were scrutinised by experts according to their relevance for research questions in conservation biology and ecology. Twenty-one statements were selected to which conservation biology and ecology can provide relevant research outputs. In the third stage, the 21 relevant statements were prioritised, and rephrased and restructured by an expert panel using the Delphi method (Dalkey and Helmer, 1963; Rowe and Wright, 2001) with a Likert scale (Chyung et al., 2017). The Delphi method is a structured, multi-round, questionnaire and feedback-based communication method that aims to reach consensus among experts when formulating their opinions (Dalkey and Helmer, 1963; Rowe and Wright, 2001). For this exercise, twenty experts from the Scientific Committee on Ecology of the Hungarian Academy of Sciences and nine from related academic committees were invited from a wide range of relevant disciplines (theoretical ecology, restoration ecology, conservation ecology, urban ecology, landscape ecology and others; see the author list) to process the future agenda in line with global research trends and challenges. We developed two consecutive questionnaires and sent them online to the expert panel. Participants were then asked to provide input and send back their responses. In the first questionnaire, researchers were tasked to rephrase the future statements into relevant research topics that hold importance to both science and society. We also asked them to identify and rank on a five point Likert scale those research topics that, in their opinion, could most significantly contribute to improving biodiversity conservation. The scores on the Likert scale from 1 to 5 had the following meanings; 1: the research question is not important at all, 2: not important, 3: important, 4: moderately important, 5: very important. In their feedback, experts were free to restructure research topics into priority research areas or suggest brand new research areas. As a result, the initial 21 research topics were reduced and merged based on discussion and vote-counting into a final list of 14 priority research topics. In the second questionnaire (fourth stage), the final list was disseminated to the participating scientists for further suggestions and for scoring on the same Likert scale (Fig. 1). As the last stage, we developed seven clusters to categorise the 14 statements.

3. Results and discussion

3.1. Conservation biology research priorities based on 2050 horizon scanning

Based on the conservation-relevant future statements from the Environmental Foresight – Hungary 2050 report (Hideg et al., 2019), we identified the most important knowledge gaps and transformed them into research topics using the Delphi method. The researchers had to focus on topics and realistic research questions that also represent high value to both science and society. Twenty-one experts accepted the invitation covering various fields of terrestrial and aquatic ecology, and based on their feedback, we developed the final agenda of priority research issues. We defined fourteen research topics within seven main clusters relevant to biological conservation that should be targeted by stakeholders, primarily policy makers and funders in focusing research capacity. Below we present the final 14 research topics grouped by similar themes and split into seven clusters (Fig. 2). We added the expert scores of each future research topic, but the order does not express importance, because there were only

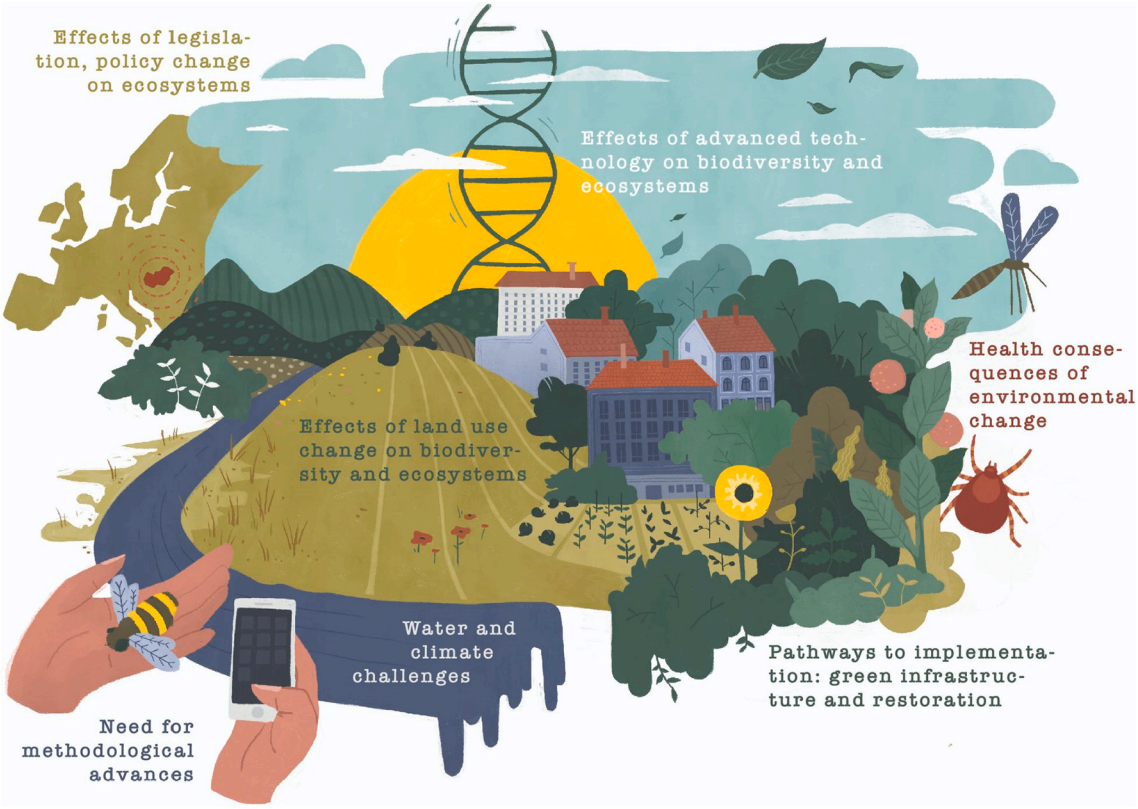

Fig. 2. The seven main clusters including the fourteen ecology-relevant priority research topics.

small differences in research topics during prioritisation.

Cluster 1: Effects of land use change on biodiversity and ecosystems

- Study of land use changes and different management practices: innovative technologies, the localities of natural values and protected areas, the impact of temporal changes and landscape diversity on local biodiversity. (4.65)
- Determining the land use that best suits natural conditions and ecosystem services taking into account the socio-economic context of natural and cultural values with special emphasis on the traditional management of natural resources. (4.59)
- The impact of landscape structure and connectivity of natural habitats on the species composition, functional diversity and ecosystem functions of habitats. The role of secondary, anthropogenic and degraded habitats in maintaining connectivity. (4.12)

Cluster 2: Pathways to implementation: green infrastructure and restoration

- Restoration ecology: analysis of the potential for habitat restoration including spatial prioritisation and the stability of restored habitats under changing land use and climate. Assessment of knowledge, development of methods, and experimental studies on the restoration of ecosystems and ecosystem functions that are less known in terms of restoration potential. (4.50)
- Urban ecology: assessment of the wildlife, ecosystem processes, and the elements and connectivity of green infrastructure of urban and urbanising areas. Protecting urban natural values, mitigating the effects of climate change and creating urban green spaces (e.g. grasslands, community gardens, bee pastures) with the involvement of local stakeholders. (3.41)

Cluster 3: Effects of legislation, policy change on ecosystems

- Strategic research cooperation with neighbouring and regional countries to protect the natural values of Central and Eastern Europe (e.g. steppes, wetlands, primeval forests and their characteristic species), study of traditional land use practices that ensure their survival, and exploration of the possibilities of integrating them into support systems. (4.15)
- Harmonisation of regulation and practice in the use of native species and populations from a given region in green infrastructure development. (3.29)

Cluster 4: Health consequences of environmental change

- Research on invasive species and pathogens emerging due to globalisation, climate change and land use change to protect native elements of the biota and prevent the outbreak of epidemics. (3.82)

Cluster 5: Effects of advanced technology on biodiversity and ecosystems

- Conservation genetics of native and endangered species – assessment of inbreeding and genetic diversity. Establishment of an animal and plant DNA/seed/living cell line bank in the region for long-term conservation. Testing the propagation conditions of important native grasses and forbs with the involvement of seed producers to support the restoration of grasslands. (3.77)
- Adaptation and development of info-communication technologies and big data techniques in order to achieve nature conservation goals. (4.18)

Cluster 6: Water and climate challenges

- The role of water in the lowlands: studying the potential for water retention, and its feasibility and mechanism in mitigating the effects of climate change, in order to diversify agricultural cultivation and

preserve species and habitats of high conservation importance. (4.53)
- Assessing the impacts of the climate becoming more Mediterranean and the increasing frequency of extreme weather events on aquatic and terrestrial ecosystems; modelling the effects of climate change by analysing long-term data sets. Determining carbon-dioxide turnover for major ecosystem types. (3.88)

Cluster 7: Need for methodological advances

- Habitat modelling in the light of accelerating climate change and ranking of the species most endangered by habitat transformation using these models. (4.35)
- Involving broad sections of society in science: increasing the impact and potential of applying citizen science in learning about and conserving biodiversity. (3.65)

3.2. Comparison with other prioritisation studies

In a previous Hungarian prioritisation of conservation research (Mihók et al., 2015) 792 research questions were collected from conservation practitioners and managers based on interviews (109) and online questionnaires (683) of which the final 50 currently most important questions were identified and grouped into 12 main themes by practitioners and policy makers during a stakeholder workshop. The final list of questions was not prioritised. In contrast, our study focused on the future natural state of Hungary until the foreseeable time horizon of 2050. The invited 30 scientists and experts attended 3 different brainstorming workshops which resulted in a list of 60 future statements, grouped into 3 main categories (Hideg et al., 2021). After that 21 conservation relevant future statements were selected and scrutinised by ecologists. To fill the online questionnaires 29 other experts were invited who created the final 14 priority research topics. The topics were ranked and categorised into seven main clusters. We found small differences between research topics (see scores above).

Mihók et al. (2015) highlighted the most pressing issues of ecological, technological and economic opportunities for grassland and wetland restoration, continuous cover forestry for enhancing biodiversity, as well as game management, along with habitat management, land use and regional development, and human-wildlife conflict issues (Mihók et al., 2015). We found that the main overarching themes across the research topics were climate change, biodiversity loss, land use, ecosystem services, and restoration efforts. Interestingly, the overlap between priorities identified previously and in this study is relatively low. This can be explained by the partly different sets of experts participating in the development of the priority lists. While the study of Mihók et al. (2015) was built on information from conservation practice (conservation managers, national park staff, NGOs etc.), this exercise used future statements on the environment of Hungary in 2050 as a starting point. It seems therefore that research priority lists can be sensitive to the starting conditions and targets.

In line with recent horizon-scanning studies in conservation (Williams et al., 2020; Sutherland et al., 2021), we found that the main current research topics were related to the conservation of ecosystems, mitigation of anthropogenic climate change and decline of biodiversity. Questions of ecology, biodiversity conservation and restoration, rural development and policy, landscape planning, sustainable agriculture and climate change are the most significant topics emerging from prioritisation throughout Europe and the world (Weeks and Adams, 2018; Ockendon et al., 2018; Lõhmus et al., 2019; Dey et al., 2020; Sutherland et al., 2021; Williams et al., 2020). The results presented here also highlight that the sustainable management of ecosystems may be achieved in different ways: by nature conservation, by rural policy or by spatial planning, among others. This corresponds to the findings of Ockendon et al. (2018), who revealed that the questions focusing on the management of ecosystems and landscape restoration are diverse. In previous prioritisation studies experts provided their opinions to fill present knowledge gaps, while in our study scientists define research questions addressing future environmental and conservation statements. For example, what evidence-based knowledge is needed to avoid the predicted increase of droughts in the Pannonian Region. By this novel approach we channelled the experts' opinions to focus on the future state of Hungary and the region.

3.3. Future Hungarian research topics in a CEE policy context

To understand post-socialist Hungary's future conservation issues, they need to be placed into a social-historical context, and robust political changes in CEE countries need to be examined. The historical and political development of post-socialist CEE countries is similar, although with different local factors (Yakusheva, 2019). Collectivisation in the 1950s had a serious impact on biodiversity not only in Hungary, but also in other post-socialist countries. For example, in Slovakia and the Czech Republic, small-scale family farms were integrated into large state farms and cooperatives (Swain, 1999), agriculture was enormously intensified: monoculture field size increased and more and more chemicals were used (Ángyán et al., 2003). By contrast, in some CEE countries (e.g. in Poland, Romania) small family farms have remained (Tryjanowski et al., 2011; Babai et al., 2015).

The transition to democracy led to new economic, political and legal frameworks, and introduced a conceptual approach to nature conservation policy (Yakusheva, 2019). From 1989, centrally regulated socialist state economies transitioned toward market-orientated economies which strongly affected biodiversity and ecosystems both positively and negatively (Báldi and Batáry, 2011a). These changes contributed to higher biodiversity in farmlands due to extensification and abandonment of fields and less use of fertilisers and pesticides. In Hungary, similarly to other post-socialist countries, conservation institutions were strengthened and new protected areas were established. On the other hand, land privatisation caused habitat degradation and fragmentation, which led to re-ploughing (Mihók et al., 2015, 2017). Many extensively used lands were abandoned (e.g. in Hungary, Poland, Slovakia, Ukraine, Romania; see Kuemmerle et al., 2008; Liira et al., 2008; Pazúr et al., 2014; Lieskovský et al., 2015; Cegielska et al., 2018; Feranec et al., 2000), and former pastures and species-rich hay meadows today are threatened by non-native invasive species or intensive use by large companies (Molnár et al., 2012; Csecserits et al., 2016; Balázsi, 2018).

The 2004 accession of several CEE countries to the European Union led to changes in their environmental policy: new obligatory policy elements were established, such as the Natura 2000 network (CBD, 2014). New incoming EU funding streams for conservation (e.g. LIFE programs, rural development funds, agri-environment schemes) began to open up, which contributed to habitat and species protection, ecological restoration, and the greening of agriculture. However, increasing EU Common Agricultural Policy (CAP) subsidies mainly contributed to agricultural intensification, which does not benefit biodiversity either in post-soviet or in WE member states (Pe'er et al., 2014, 2020; Leventon et al., 2017). The adverse effects of CAP were well known before it was introduced to new member states in 2004 (Donald et al., 2002), yet it was applied without any correction or modification to the local context (Báldi and Batáry, 2011b). Therefore, large scale significant changes in the environment happened since the regime change in CEE, without considering scientific advice and research evidence (Sutcliffe et al., 2015).

The current European Green Deal recognises that there is an urgent need to overcome environmental challenges. The future CAP reform must be compatible with the Green Deal policy and its Biodiversity strategy for 2030, which aims to protect nature and reverse ecosystems degradation in the long term. Unfortunately, only a few EU member states have started developing ecological restoration strategies to postpone biodiversity decline and ecosystem degradation or evaluated the restored areas at the country level (e.g. Nordic countries, Hagen et al., 2013; Tolvanen and Aronson, 2016). In Hungary, according to the study

of Török et al. (2019), in 2002–2016 1.06% to 5.29% of restored area was achieved regarding ecological restoration, depending on what we consider restorable land. These efforts are far from the current target of 30% (UNEP/FAO, 2020), so future science–policy discussion has to focus on effective restoration in practice (Fischer et al., 2021).

The constitution of Hungary clearly states that it is the government's responsibility to protect all natural resources, especially agricultural land, forests, drinking water supplies and biodiversity (HC, 2011). Contrary to this, institutional changes have reduced the power of nature conservation – the Ministry of Environment and Water was decommissioned and transferred to the Ministry of Rural Development (now the Ministry of Agriculture) (Krasznai, 2021). The other obstacles are the slow progress of the sectoral integration of environmental policy, the inadequacy of long-term monitoring of management actions and accessible monitoring databases, and the fact that basic conservation research focusing on habitat/species monitoring is often considered incompatible with a successful scientific career (Mihók et al., 2015, 2017; NKP, 2021). So it is time to strengthen the advocacy of nature conservation efforts within the government and in the non-governmental and civil sector and take adaptive social and institutional action in Hungary and other CEE countries (Krasznai, 2021). The 5th National Environmental Program is under planning now, and is expected to be adopted by the Hungarian government in 2021 for 2021–2026 (NKP, 2021). The plan in line with the 8th EU Environment Action Program (EAP) includes efforts for increasing sectoral cooperation, reviewing environmental legislation, improving the institutional and economic background for nature conservation, as well as the efficient use of EU funds, cooperation with society, and supporting practical conservation research in national parks.

Although the vision of green transition for 2050 was already established in the 7th and 8th EAPs, the implementation is a challenge necessitating socioeconomic changes. The main conservation research topics identified by our agenda set concrete goals for the future that have to be implemented to avoid further loss of biodiversity. The aim was to formulate general topics that are valid and incorporable into Hungarian and CEE policy. But we also suggest local changes to conservation management by individual regions (Tryjanowski et al., 2011; Yakusheva, 2019). E.g. in Hungary, agriculture and forestry have a major impact on biodiversity (60.3% of the country is agricultural land, 20.7% is forests or forest plantations; CBD, 2014), therefore it is especially important to link land use planning to the European Green Deal policy and to its relevant strategies on biodiversity, agriculture, forestry, etc. (treated in *Cluster 1*, *Cluster 3* and *Cluster 4* of the identified research topics). In many other post-socialist countries (e.g. Slovakia; Pazúr et al., 2014; Lieskovský et al., 2015) the abandonment of agricultural fields has increased, but besides the potential negative effects of abandonment, old-fields also provide an opportunity for passive and active ecological restoration to increase biodiversity (Csákvári et al., 2021) (*Cluster 2*). Other research questions (*Cluster 5* and *Cluster 7*) are more thoroughly addressed in WE than in CEE (e.g. scientific knowledge regarding biodiversity; Tryjanowski et al., 2011), but are increasingly important for effective conservation activities in CEE as well. The research questions of *Cluster 3* and *Cluster 6* may be particularly relevant to the protection of values in the Pannonian biogeographical region.

3.4. Tackling future conservation challenges effectively

Prioritisation studies may improve the effective allocation of governmental and other spendings, but it is also important that they connect the diverse groups of stakeholders during the preparation of prioritisation, and usually improve the communication across the science–policy interface (Dey et al., 2020). As such considerations and steps are mostly related to legal authorities, usually at the national government level, the most effective way is to provide priority lists for countries, where these can be directly addressed by policy and practice, without time consuming international negotiations. The 14 research topics identified here include a wide range of approaches and solutions, such as innovative technologies, involvement of local stakeholders and citizen scientists, legislation, and issues related to human health. All these indicate that solutions to conservation challenges require a multidisciplinary approach in design and a multi-actor approach in implementation. The development of such working methods and culture requires investment from the funders concerned, the national and local governments and from the whole stakeholder community to establish effective and permanent dialogue between researchers, practitioners, policy makers and society.

Priorities will vary by region depending on political, social and economic background, therefore environmental policies that apply for WE (or on a global scale) cannot be readily applied to the CEE region without changes. Regional studies however can be used to jointly identify global aspects. Concerning the uptake of our results, the national government could likely be the most effective level to initiate research projects to fill the identified knowledge gaps, although multinational sources such as the Visegrád Fund and the European Union (e.g. Horizon Europe, BiodivERsA/European co-funded Partnership of Biodiversity) may also play important roles. There are several cross-cutting research topics, which need to be understood in multidisciplinary and transboundary studies. Most crucially of all, immediate action is needed using this evidence (Báldi, 2019; Ruckelshaus et al., 2020).

4. Recommendations

By identifying and summarising the most important research topics for conservation biology, we call on the national and local governments and research funding bodies to adjust their priorities to extend funding for the research topics identified to fill these conservation knowledge gaps by initiating multidisciplinary, multi-actor research and innovation projects. Although the research priorities identified in this study were listed for Hungary, they are in line with European and global biodiversity strategies, and can be tailored to other CEE countries. If knowledge gaps are filled by research projects initiated based on our list of priorities and policy requirements are fulfilled, biodiversity could be preserved more effectively, contributing to human well-being as well.

Therefore, we suggest (i) transboundary and multidisciplinary collaboration to fill the knowledge gaps in the field of conservation biology aligned with European and global biodiversity targets, (ii) to use new research evidence for the effective conservation of ecosystems under climate change, (iii) to initiate effective and permanent dialogue between researchers, practitioners, policy makers and society, (iv) to ramp up the implementation of research priorities in practice and (v) to increase lobbying and to allocate funds for novel research programmes on the operative level.

CRediT authorship contribution statement

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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

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