Congruence between the prioritisation of conservation problems at the local and national scale: an evaluation by environmental scientists in Poland

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Abstract

The anthropogenic pressure on the environment depends on the spatial scale. It is crucial to prioritise conservation actions at different spatial scales to be cost-efficient. Using horizon scanning with the Delphi technique, we asked what the most important conservation problems are in Poland at local and national scales. Twenty-six participants, PhD students, individually identified conservation issues important at the local and national scales. Each problem was then scored and classified into broader categories during the round discussions. Text mining, cross-sectional analyses, and frequency tests were used to compare the context, importance scores, and frequency of identified problems between the two scales, respectively. A total of 115 problems were identified at the local scale and 122 at the national scale. Among them, 30 problems were identical for both scales. Importance scores were higher for national than local problems; however, this resulted from different sets of problems identified at the two scales. Problems linked to urbanisation, education, and management were associated with the local scale. Problems related to policy, forestry, and consumerism were more frequent at the national scale. An efficient conservation policy should be built hierarchically (e.g. introducing adaptive governance), implementing solutions at a national scale with the flexibility to adjust for local differences and to address the most pressing issues.

Keywords Biodiversity · Environments · Conservation · Policy · Prioritisation · Spatial scale

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Introduction

Conservation biology is a multidisciplinary science that has been developed to address the loss of biological diversity (Meine et al. 2006; Gerber 2010). This discipline addresses a vast range of problems; however, some of them are common and recurring. At the global scale, issues such as climate change (Sutherland et al. 2009), pollution (Farmer 1997), habitat fragmentation (Haddad et al. 2015), invasive species (Lenda et al. 2014; Early et al. 2016), water pollution (Schwarzenbach et al. 2010), and urbanisation (Nieuwenhuijsen 2016), among many others, are commonly mentioned. Most recurring problems related to nature conservation are connected to daily human life (e.g. Soga and Gaston 2016) and can have different values depending on the individual perspective (Tsfaye et al. 2011; Coleman et al. 2019).

individually scored every problem from 1 (not important) to 10 (extremely important). Finally, all participants discussed scores, classified identified problems into broader categories, and attempted to establish final, agreed scores for each problem.

Statistical analysis

To identify the most relevant conservation problems at different scales, we calculated the mean scores for each identified problem (Supplementary Material 2). We then chose 25 top-scored problems at both the local and national scales to present in the graphs. We used cross-sectional analysis (hereinafter referred as the “plm model”) implemented in the “plm” R package (Croissant and Millo 2008) to check for differences in mean scores between local and national scales, including the participant identity as a random factor. The same analysis was used to compare the importance scores of the common problems for the two spatial scales with importance scores of unique problems identified for pooled data and for each spatial scale. Further, all identified problems were classified into 14 broader categories for easier comparisons between the two spatial scales. We used the chi-square test to compare the frequencies of the different categories between spatial scales. The comparison was performed for all identified problems, both including and excluding repetitions (when different participants identified the same conservation problem). Related categories with frequencies below 10 were merged to meet the assumptions of the chi-square test. All statistical analyses were performed using R (R Core Team 2019). Means are presented with standard errors, and visualisations were performed using the ‘wordcloud’ (Fellows 2018) and ‘ggplot2’ (Wickham 2016) R packages.

Results

We identified 115 and 122 conservation problems at the local and national scales, respectively. Individual scoring of the conservation problems identified in the first scanning round revealed slightly different importance of problems, especially at the national scale (Figs. 2 and 3, Supplementary Material 2). Participants decided that scoring during the first round gave satisfactory estimates of problem importance and resigned from the second round of scoring. Generally, national problems had, on average, slightly higher importance scores (estimated mean = 7.47 ± 0.05 , $\chi^2 = 71.784$, $df = 1$, $P < 0.001$) than those in local problems (estimated mean = 6.97 ± 0.16). However, this difference disappeared if only 30 (24%) identical conservation problems for two spatial scales were compared (estimated mean for local scale = 7.42 ± 0.18 , for national scale = 7.5 ± 0.10 , plm model $\chi^2 = 0.694$, $df = 1$, $P = 0.405$). The common conservation problems had higher

importance scores (7.41 ± 0.09) than unique conservation problems on a local spatial scale (6.81 ± 0.16 , plm model $\chi^2 = 51.064$, $df = 1$, $P < 0.001$). However, importance scores did not differ between common conservation problems (7.50 ± 0.08) and unique conservation problems (7.37 ± 0.16) at the national scale (plm model $\chi^2 = 3.132$, $df = 1$, $P = 0.078$). On a national scale, climate change had the highest scores. Moreover, intensive forestry, lack of knowledge and social awareness, and ignorance about biodiversity conservation also gained high scores (Fig. 3). At the local scale, problems related to environmental pollution, especially air and urbanisation, had the highest scores (Fig. 2).

All identified problems were classified into 14 larger categories (Fig. 4, Supplementary Material 2). When we compared these broader categories, we found that problems linked to urbanisation, education, and management were more associated with the local scale than the national one ($\chi^2 = 23.22$, $df = 7$, $P = 0.002$, Fig. 4a). However, problems related to policy, forestry, and consumerism were more frequent on the national scale (Fig. 4a). The results remained the same when repetitions were removed (e.g. the same problem was identified by different participants; $\chi^2 = 18.69$, $df = 7$, $P = 0.009$, Fig. 4b).

Discussion

The success of conservation strategies depends on their applicability across spatial scales. There is a need for coordinated actions at all levels, including national, provincial, and local scales (Ostrom et al. 1999; Beger et al. 2015). This requires flexibility in policy, which may be based on adaptive governance (Berkes 2017). It recognises multiple interests, community-based initiatives, and integrative science that reconcile differences among conservation problems between spatial scales (Brunner et al. 2006). However, before assessing the effectiveness of any intervention, the volume of the problems, their importance, and the scale of each problem must be considered.

Generally, there was congruency between broad problem categories in the two spatial scales; however, specific problems at the national scale had higher scores than local problems. The latter finding probably resulted from different sets of specific problems identified at two spatial scales because the importance scores of conservation problems that were identical for the two spatial scales had similar values. Moreover, these common problems had higher importance scores than unique problems on a local scale, however, not at the national scale. This result may be essential for prioritising conservation actions. Addressing problems common to two spatial scales may be a good strategy as they link these scales and require integrated actions. Coordinated conservation may achieve national or global conservation goals more efficiently because almost all resource management

Fig. 2 Top 25 local conservation problems based on mean scores ($\pm$ SE) among all identified conservation problems at the local scale

actions are established hierarchically through national, provincial, and local planning processes focused on solving the same set of problems (Beger et al. 2015).

Local conservation problems are evident when they result from the lack of appropriate environmental education or

ignoring scientific evidence (Barron et al. 2005). Environmental education facilitates connections between actionable research findings and on-the-ground practices, creating synergistic spaces where stakeholders collaborate to address dynamic environmental issues that may directly benefit

Fig. 3 Top 25 national conservation problems based on mean scores ($\pm$ SE) among all identified conservation problems at the national scale

Fig. 4 Comparison of frequency of different categories of problems at the local and national scales with (A) and without (B) repetitive problems

the environment and achieve conservation goals (Ardoin et al. 2020). Problems with education were identified as the most troubling issues on the local scale. Indeed, it corresponds with the general phenomenon that problems related to environmental education and awareness in Poland arise (Machnik-Słomka and Kłosok-Bazan 2017). Knowledge about the environment is derived mostly from school education and mass media (Kobierska et al. 2007). Therefore, it is crucial to establish well-defined educational programmes regarding the environment and its conservation. They are currently underdeveloped and require a novel attitude (Hłobił 2010; Falencka-Jabłońska 2017). Teachers should address this topic in a more modern and active way, involving the use of media (i.e. TV, Internet, social media, and computer games). Topics about environmental protection are mandatory in all school subjects under Polish legislation (Śledzińska et al. 2016); however, they are generally focused on general issues and ignore local differences (Falencka-Jabłońska 2017). Addressing environmental problems at all levels requires teaching based on causal thinking skills rather than boxed knowledge (Falencka-Jabłońska 2017) and choosing teaching topics adjusted to local environmental issues (Buchcic 2002; Stoczowska 2002). Although problems

linked to environmental education were mostly associated with the local scale, it is clear that this issue requires a broader change at the national policy level (Grodzińska-Jurczak 2004; Kobierska et al. 2007). One possible solution would be to increase the number of environmental education centres (Pitowska and Lazarides 2013). The operation of environmental education centres influences students and local communities, especially when the centre operates in peripheral and disadvantaged areas (Pitowska and Lazarides 2013). Thus, such centres can play a very important role in the development of education for both students and adults, transforming local communities to solve future environmental problems.

Interestingly, urbanisation appears to be one of the major issues at the local scale. Towns and cities are currently the most rapidly developing areas globally, having a profound effect on the environment and biodiversity (Marzluff et al. 2001; Skórka et al. 2006, 2016; Evans et al. 2010). Urbanisation is associated with many phenomena, including urban sprawl, road development, noise, increased human density, and pollution. All of them have an immediate effect on local wildlife and can be easily perceived by non-professionals. Environmental phenomena, such as climate change,

become more pronounced due to urbanisation, which may lead people to consider it more recognisable on a local scale. Urbanisation implies environmental changes, however, also a political change to manage growth, which can be controlled and planned (Dodman 2017). This is where local governments are most needed, and the attitude of local authorities is crucial (Karwińska et al. 2018). The lack of actions to plan and control urbanisation processes will make them even more pressing problems, including economic and social dysfunction for humans (Litynski 2016; Karwińska et al. 2018). In addition, the history of a particular urban area and place attachment may play a role in perceiving conservation problems, and this may also be the reason why urbanisation is considered a major problem on a local scale (Buchecker and Frick 2020).

The above problems relate to general environmental policy, which is a challenge for both the Polish government and non-governmental organisations. Furthermore, the effectiveness of environmental policy appears to decline across the region of Eastern and Central Europe (Szulecka and Szulecki 2019). The shortcomings of policy were identified in our horizon scanning as belonging to major problems at the national scale. Thus, we propose that further work of the Polish government should focus on the full implementation of the International Standard for Environmental Management Systems ISO 14001 (<https://www.iso.org/iso-14001-environmental-management.html>). This policy should have a strong legal basis, but it should also be straightforward and easy to understand, representing a comprehensive approach to environmental issues. This should be based on adaptive governance, including flexible and learning-based collaborations and decision-making processes involving both state and non-state actors at multiple levels, to adaptively negotiate and coordinate management in human-environment systems (Brunner et al. 2006; Tesfaye et al. 2011). However, most importantly, environmental rules and regulations should be strictly followed. In this regard, an initial environmental examination or impact assessment should be conducted before starting any kind of project (Niedziałkowski 2013).

Neglecting law regulations has sparked the recent conflict between Polish state forests and the scientific community and non-governmental organisations (Żmihorski et al. 2018). The conflict arose as Polish state forests started cutting protected Białowieża Forests, violating environmental policy and law (Schiermeier 2016; Żmihorski et al. 2018). The conflict then spread because intensive and uncontrolled logging encompassed other forest complexes (Szulecka and Szulecki 2019). Intensive forestry was also identified in our scanning as a prevalent national problem. Intensive forestry is also related to habitat loss and fragmentation at this scale (Mikusiński et al. 2018; Thorn et al. 2018).

Interestingly, only one problem (the lack of green technologies) could be classified as related to science while considering broad categories. This indicates that the current

accumulation of knowledge is satisfactory for undertaking practical actions and solving most of the problems. This also shows that the role of conservation science may change, solving problems regarding how to incorporate accumulated knowledge into legislation and policy, and how to deliver this knowledge to society (Mace 2014; Sutherland et al. 2019).

As we have already demonstrated, particular conservation problems vary in their relative importance according to the spatial scale. Our identification of the top questions for environmental conservation in Poland and the themes that emerged provides an overview of research areas that scientists commonly identified as priorities for the entire planet and certain regions, including Europe (e.g. Sutherland et al. 2013; Ockendon et al. 2018). The indicated problems are well-documented, and some solutions have already been published in the scientific literature (Farmer 1997). For example, environmental pollution was found to be a relevant problem at both scales; however, scoring revealed its importance mostly at the local level. Environmental pollution, in general, is a global problem that comprises different categories such as air, light, water, soil, noise, and heavy metal pollution. Thus, every category of pollution may act on different spatial scales. These problems are correlated with human activities and strongly affect human health (Lim et al. 2012).

In contrast, climate change is perceived as the most important national problem. Climate change forecasts predict that habitats sensitive to moisture levels will suffer if the climate becomes drier (Letcher 2009). Climate-related alterations in habitats could impact food production, water supply, and quality, as well as the use of land for tourism and other leisure activities. Reduced soil moisture is linked to an increased risk of wildfires (Pickrell 2019) and a higher vulnerability of species to pests and diseases (Cannon 1998). The clear change in climate dynamics is the biggest influence of climate change on the environment in Poland (Kundzewicz and Matczak 2012). These climate changes have forced the intensification of several weather phenomena, such as droughts, hurricane-force winds, tornadoes, and hail (Kundzewicz and Matczak 2012). Thus, our scoring confirmed that this is a major conservation issue.

Methodological considerations

Our Delphi technique was used to encourage consensus on specific themes. Contrary to this assumption, our discussions resulted in contrast opinions than in other published problem solving (review in Hilbert et al. 2009). Finally, participants agreed that determining the mean score of problems during the first round was a better option than seeking a unified score for each problem. This method has several advantages. First, it shows that finding a consensus on the discussed problem among specialists is difficult or sometimes even impossible. Second, the use of mean scores and associated measures of

variation depicts differences in the perception of the importance of different problems among participants. This is valuable information that can be used in modelling and decision-making. For example, one may use the value of variation in scores among participants to assess how much they agree with a given problem. Delphi is a flexible technique, and individual variation may be incorporated in agreed opinions on different topics.

Our study includes the opinions of PhD candidates linked to ecology and conservation science. This may raise concerns if this horizon scanning represents of the entire country and if the identified problems and their order of importance scores are correct. Moreover, it is unknown if research participants could represent the perception of conservation problems in Polish society. However, participants of many horizon scanning should be professionals rather than randomly chosen individuals because horizon scanning and Delphi techniques explore the knowledge of participants rather than collecting opinions (Sutherland et al. 2011; Mukherjee et al. 2015). In our research, participants were young professionals, and their opinions may shape future decision-making. Nevertheless, it is desirable to conduct similar research with a higher number of experienced professionals from different institutions and compare their opinions with horizon scanning performed with a random sample of citizens that represents the entire Polish society. Such a comparison would enable the identification of gaps between the transfer of knowledge from science to society and would also be a good base for actions or programmes informing (in educational media or school programmes) about certain conservation issues underestimated by ordinary people in both local societies and at the national level.

Conservation problems were identified on two different spatial scales. However, the complexity of the problems may cause this distinction to be artificial. For example, one may consider problems at a regional scale (not considered in this study). Moreover, problems may fluctuate across the spatial scales. This would require longitudinal analysis with the identification of problems at different times. For example, the importance of urbanisation as a conservation problem may increase in the future, as this is a rapidly ongoing process (Antrop 2004).

Conclusions

There is a certain congruency between the identified problem categories at the local and national levels. However, specific conservation problems have different importance depending on the scale, which results from the fact that 86% of the problems were unique for a scale. Thus, our findings may guide the government and local decision-makers about which problems are perceived as the most important and should be adequately solved first. An efficient policy should be built in a

hierarchical way, including solutions that can be implemented on a nationwide scale and enough elasticity to adjust for local differences in conservation issues. Broad categories may be considered first, followed by the importance of specific problems within these categories. The concept of adaptive governance (Berkes 2017) appears to be especially suitable for practical implementation, as it involves different actors (local societies, local and national governments, and experts). Moreover, 30 specific conservation problems were identical between the spatial scales. They may be priority problems to address because they had higher importance scores than unique problems at the local scale and did not differ in importance scores from unique conservation problems at the national level. However, the limitations of our study should also be considered. Our analysis is the first step in recognising conservation problems in Poland, performed by young environmental scientists. This kind of study should be repeated with a broader panel of experts and should include the collection of opinions on conservation problems in Polish society. This would enable identification gaps in societal knowledge of conservation issues across spatial scales.

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Author contribution P.S. conceived the idea, analysed data, and wrote the manuscript. All authors participated in the research, collected data, built the database, participated in writing, discussed, and commented on earlier drafts. All authors have read and approved the final manuscript.

Availability of data and materials

All data generated or analysed during this study are included in this published article and its supplementary information file.

Declarations

Ethics approval and consent to participate Not applicable

Consent for publication Not applicable

Competing interests The authors declare no competing interests.

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