

4.5 The 50 most important questions relating to the maintenance and restoration of an ecological continuum in the European Alps

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The European Alps harbour a unique and species-rich biodiversity that is increasingly impacted by habitat fragmentation through land-use changes, urbanisation and expanding transport infrastructure. Within ECONNECT, a project funded by the EU within the framework of the European Territorial Cooperation Alpine Space Programme and co-funded by the European Regional Development Fund, we initiated and implemented a trans-national priority setting exercise, inviting researchers, practitioners, NGOs, policy makers and other stakeholders from the Alpine region to participate. The aim of this study was to identify and analyse gaps of knowledge with respect to achieving, restoring and maintaining an ecological continuum in the European Alps. The exercise was composed of an initial call for pertinent questions, a first online evaluation of the received questions and a final discussion and selection process during a joint workshop. The participating 48 institutions generated 484 initial questions, which were condensed to the 50 most important questions by 16 workshop participants.

This exercise proved a useful and efficient tool to compile inputs from various researchers, practitioners, administrators, stakeholders and policy makers from different countries with a relatively low initial effort. Although we invited six policy makers to join the initiative, only two generated initial questions and only one participated in the final workshop. This problem of a non-representative group of experts lacking valuable perspectives has been pointed out by previous authors and in chapter 4.2 in this publication (Svadlenak-Gomez, Badura and Walzer). The majority of the process was performed via e-mail communication and was administered by one part-time employee. We feel that this resource-saving method is a strong argument in favour of this approach, especially given the generally limited resources for connectivity conservation.

The process identified the 50 most important questions relating to the maintenance and restoration of an ecological continuum – the connectedness of ecological processes across many scales including trophic relationship and disturbance processes and hydro-ecological flows in the European Alps. The non-prioritised list of the 50 most important questions concerning an ecological continuum in the Alps is shown in Table 7. The resulting questions were individually classified broadly in nature, people and management contexts (NC, PC, MC). The largest proportion of questions (46 percent) was attributed to the nature context. This is followed by the management context (44 percent) where by far the largest proportion of questions relates to the legislation, policy and planning needs subtopic (63 percent). Finally the people context makes up a mere ten percent of the total questions. From the 50 questions, the clear majority (60 percent) were formulated as “how” questions, followed by “what” (26 percent) and “which” questions (14 percent). Consequently, most attention was given to transformation processes aiming at practices to improve the current situation in Alpine connectivity.

The gaps of knowledge in conserving and restoring connectivity emphasised in this exercise make it evident that the assessment involves highly dynamic and interconnected processes rather than a simplistic and straightforward approach. It appears essential to reconcile the dynamic and complex nature of the problem with the available problem solving approaches. Inadequate simplification of the interdependencies will possibly lead to results that are not relevant in forming policy. Furthermore, our results indicate that maintaining and restoring ecological connectivity in the Alps is most likely a “super-wicked problem”, and this implies the need for novel approaches in addressing the issue. As has been previously suggested by other authors, we also feel strongly that the usual retrograde method of

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// **Table 7:** Non-prioritised list of the 50 most important questions

01	Which landscape elements and land use types enhance or moderate gaps in connectivity?
02	How are corridors best implemented; with clearly spatially defined borders or as functional units integrated in wide ecological continuums?
03	How do major land use changes affect ecological connectivity across the Alps?
04	What is the relative importance of climate/land-use change to changes in the ecological continuum of Alpine regions?
05	Which indicators reflect the changes in connectivity that result from climate or human induced changes in Alpine landscapes?
06	How important is connectivity in maintaining key ecosystem services?
07	How can ecological connectivity maintain the adaptive capacity of ecosystems in the face of environmental change?
08	Which of the habitat types important for landscape connectivity are most affected by climate change?
09	How does alternative energy production impact on connectivity and natural habitats?
10	What is the best method to design corridors for multiple species?
11	How severe is the current lack of connectivity between populations of alpine species?
12	What are indicators for a multi-species continuum?
13	What impacts do various seasonal leisure activities (including low-impact practices) have on ecological connectivity across the Alps?
14	How can wilderness areas (wildlife, recreation, tourism) contribute to ecological connectivity?
15	What is an effective set of indicators (that is, for species and habitats) that can be used to evaluate and monitor ecological connectivity at different scales?
16	How does the return of large carnivores affect ecosystems in the Alpine ecological network?
17	What is the impact of gene flow through an ecological continuum on genetic adaptation to climate change?
18	How does the ecological continuum allow shifts in species distribution to keep pace with climate change?
19	Are artificially engineered ecological networks a threat or a benefit to endemic species?
20	What are the consequences for both genetic and species diversity if the system of natural barriers changes?
21	How will future changes in species distribution affect connectivity and fitness among interacting species?
22	How much gene flow fostered by connectivity is beneficial to populations and species without disrupting local adaptations?
23	How can the spread of invasive species and diseases be minimized, while ensuring connectivity for native species?
24	How do elements of the ecological network affect human welfare and perception?
25	How can agricultural and silvicultural land use be optimised in order to promote and conserve ecological connectivity?
26	How can connectivity for biodiversity and ecosystem conservation become and be managed as a public good?
27	How do demographic changes in the Alps affect the future ecological continuum?

Source: Adapted from: Walzer et al. (2013). PLoS ONE, 8(1).

28	How do the aims of ecological connectivity and tourism conflict?
29	What is the most effective way to employ the different categories of protected areas to ensure connectivity and the provision of ecosystem services in the Alps?
30	How can we use and integrate existing instruments and programmes to enhance trans-sectoral funding for ecological connectivity?
31	How can ecological connectivity be integrated into spatial and infrastructural planning and legislation at various administrative levels?
32	How can legal and conceptual tools stimulate the development of trans-border connectivity?
33	How is it possible to harmonise contradictory, competing spatial sectoral policies in order to enhance connectivity?
34	Which policy-measures are necessary to safeguard the ecological network beyond protected areas?
35	Which of the existing sectoral funding systems have a positive and which have a negative effect on connectivity?
36	What incentives for agriculture and forestry are needed to maintain and restore ecological connectivity in different Alpine areas?
37	Which strategy, integration or segregation, is more appropriate for promoting ecological connectivity in different alpine areas?
38	How can we effectively manage areas heavily affected by tourism in order to maintain their function within an ecological continuum?
39	How can we enhance sharing of theoretical and empirical good practice knowledge amongst and between sectors?
40	How can the management of protected areas better incorporate functional relationships with surrounding areas?
41	Which specific restoration measures can increase connectivity?
42	What kind of monitoring is needed to evaluate the long-term efficiency of connectivity measures in the face of dynamic anthropogenic change?
43	How can an alpine-wide, accessible and effective connectivity data platform be created?
44	How can databases for existing or emerging bio- and geo-data be improved for the promotion of connectivity projects in the Alps?
45	What is the effectiveness of different methods (for example sensor data) to monitor the consequences of structural connectivity or its elements across different spatial and temporal scales?
46	What is the effectiveness of different methods to record the effectiveness of functional connectivity or its elements across different spatial and temporal scales?
47	How can we use evidence-based education to increase public awareness of ecological networks?
48	How can methods of conflict resolution be adapted and/or used to mitigate concerns and obstruction to ecological networks?
49	How should we integrate spatial and temporal dynamics into the realisation of the Alpine ecological continuum?
50	How can the species and habitat approaches to designing ecological connectivity be integrated into the process of landscape planning?

Source: Adapted from: Walzer et al. (2013). PLoS ONE, 8(1).

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investigating the past and generating selective and singular predictions, is only sufficient for “tame problems” but inadequate for a highly dynamic and interconnected process such as ecological connectivity.

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In order to address the complex issue of an Alpine ecological continuum, it appears necessary to apply a forward reasoning approach that identifies possible future scenarios and integrates uncertainties. It is somewhat surprising that questions concerning how ecological connectivity is affected and can be managed make up the largest percentage (60 percent) of the generated questions. Authors from the field of transdisciplinary research have termed knowledge related to this type of question “transformation knowledge”. These questions deal with the genesis and future development of a problem and subsequently with the interpretation and perception of the problem in the “real world”. “What” questions address determining factors of connectivity, and answers to such questions provide “system knowledge”. Finally, “which” questions address desired goals and better practices. This has been termed “target knowledge”. Each of these knowledge forms has specific challenges, and “system knowledge”

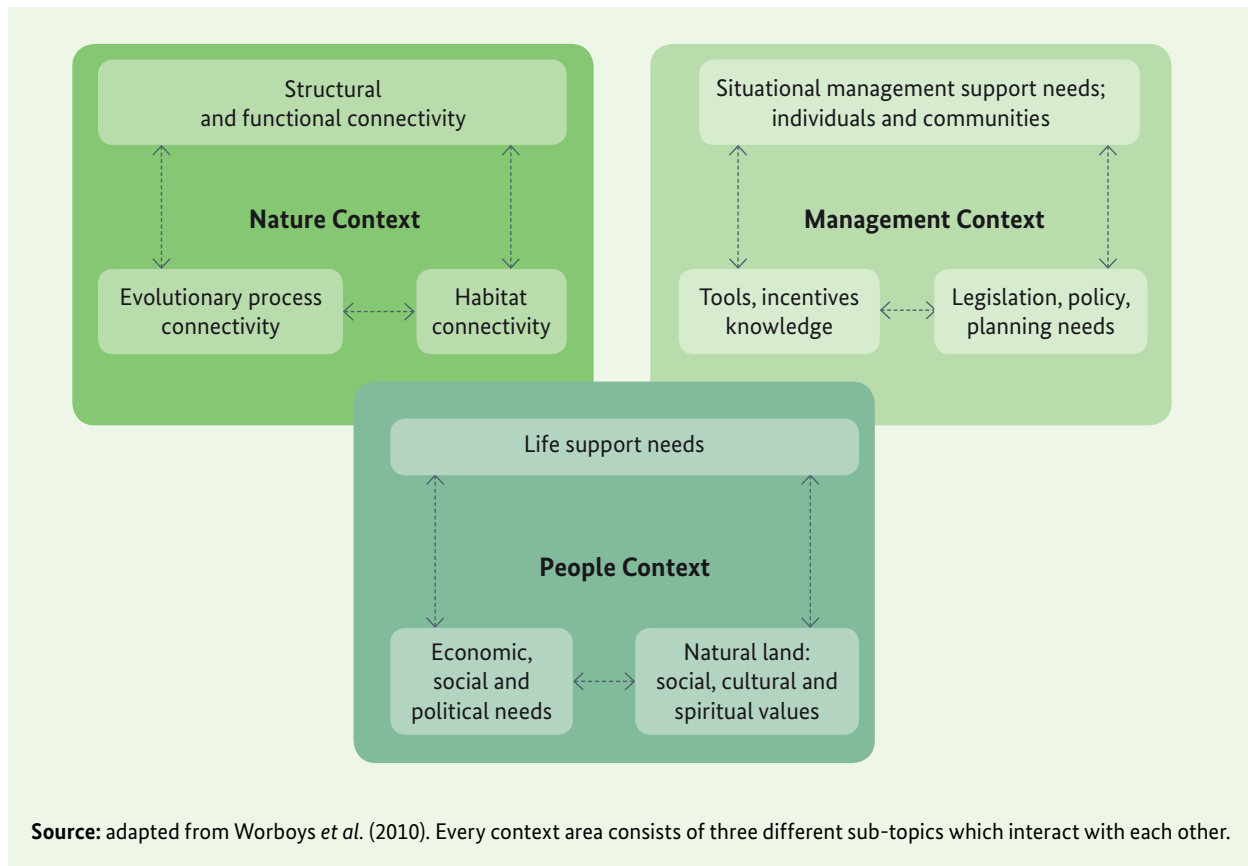
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in particular must confront uncertainties. It is essential to understand that solutions are only possible when the other postulated forms of knowledge, “target-” and “transformation knowledge”, are integrated into the solution-mix.

The visual “chaos” and multi-structural character of our results reflect the sectoral structure of society, governance and administration with respect to environmental problems in general (see Figure 22). To overcome this, an integrative transdisciplinary approach is necessary. What appears to be missing, in the search for a starting point to address the problem of the Alpine ecological continuum, is a common strategy or vision. In the authors’ view, this is also supported by the fact that the largest percentage of the formulated questions investigated the manner, condition or quality of ecological connectivity. This exemplifies the necessity of generating “system knowledge” and confronting uncertainties. Total conformity among all actors in the search for a common denominator is unrealistic and cannot be an achievable goal, as previously pointed out, but a clear vision that “expresses the joint aspirations of leaders,

// Figure 22: The three inter-related context areas of connectivity conservation



managers and participants in the initiative, without closing off avenues for constructive debate and disputation” to support and sustain connectivity conservation may be a starting point. Possibly, ecological connectivity can constitute a common “anchor” for trans-sectoral deliberations on biodiversity conservation. However, in order to not become overburdened by the complexity of the issue, it appears essential to address the inherent complexity within a well-reflected investigational framework.

For this type of study to provide guidance and contribute towards conservation-action implementation, the results must be disseminated accordingly.

As has been pointed out previously, bridging the gap of knowledge between research and conservation practice cannot be achieved with unidirectional platforms. While other authors have suggested that new platforms of bidirectional knowledge dissemination must be developed, the authors of this study believe, that

it is more efficient to employ and if necessary adapt existing information platforms inherently providing bidirectional links between policy makers, the scientific community and practitioners while encouraging more efficient cooperation with other sectors.

In the opinion of this study’s authors, an initial task of the information platform should be to organise and facilitate research and conservation-action activities centred on the inter-dependent questions identified in this study. It is the authors’ opinion that this priority setting exercise and the subsequent dissemination of results will support research and funding institutions in channelling their capacities and resources towards questions that need to be urgently addressed in order to facilitate significant progress in biodiversity conservation in Europe and specifically in the Alps. Furthermore, the definition of 50 most important questions is an important first step towards a common and harmonised approach in maintaining and enhancing ecological connectivity across the heterogeneous Alpine arch (Further reading: Adapted from: Walzer et al. [2013]. PLoS ONE, 8[1]).



Landscape impression in the Pilot Region Raethian Triangle.

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